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Electrical World

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 75 New York, Saturday, January 3, 1920 *Number* 1

A Possible Engineer-President

THE suggestion of Herbert C. Hoover's name for President of the United States is one that is sure to be heard again before the candidates are finally chosen. There is something in it that appeals to engineers, irrespective of their political affiliations, not only because of the splendid accomplishments of Mr Hoover but also because every group of men likes to see one of its own number attain high place. Of the twenty-seven men elected Presidents of the United States, twenty-one had at some period of their lives been lawyers, but only one had ever been an engineer. He, however, was the first and greatest of the Chief Magistrates.

There is one thing that sets Mr. Hoover's work in Europe apart from that of most of the other men who won world-wide fame in the fight against autocracy. They by a cruel compulsion were forced to serve the cause of civilization by destruction. Hoover's work was constructive. While Foch and Haig and Pershing, backed by the civil leaders of their respective nations, forged with sad hearts the thunderbolts of war and as a fearful necessity sent army after army to the shambles, Hoover's part was to conserve human life behind the lines and to build up shattered morale. His task was in direct line with the traditions of his profession, which is instinct with the impulse to build and to save, not to consume or destroy.

The electrical industry has advanced so rapidly and has grown to its present huge proportions because engineers have steadily forced development by continually making changes in the direction of improvement. Types come and go not because they are defective in themselves but because they do not meet changes in conditions.

Wanted—Incentives to Initiative

IT is needless to descant on the condition in which the steam railroads and electric street railways of the country find themselves. Icabod is written across the face of both. Denied adequate rates to offset rising costs, there could be but one outcome—failure, and with that went all semblance of service to the public. Government control and operation offers no solution, for the national government overtook to run the steam railroads effecting all economies which singleness of control make possible, only to pile up a huge deficit despite increased rates and inferior service, and is willing now to return the railroads to private ownership again next March. While the electric public utilities have not yet come to such a sorry plight, they will soon head in that direction if increased rates are not quickly forthcoming. Already they begin to show signs of fatigue from the strain of trying to make both ends meet at a time when conditions are worse than they were during the war. Huge investments for new equipment and extensions are necessary to meet the pressing demands for service, but the earnings of the utilities are such that they cannot command these additional moneys except at pawnbroker rates. The eventual outcome of such a situation is to bring about a condition comparable to that under government ownership, where everything appertaining to the business is permitted to drift. Great opportunities confront the industry, the greatest in years, but because of lack of funds it cannot avail itself of them, and yet if these opportunities are not grasped the whole community suffers as well. Gone is the incentive to that initiative under which the electric public utilities went forward by leaps and bounds, and if the old-time vigor is to be resurrected greater returns must be forthcoming as an inducement for financial aid and as a reward for efficient management.

Near the height of the coal shortage in wartime, it was to a central station instead of to a munitions plant that a preferential supply of fuel was scheduled by the authorities in one of the Atlantic seaboard states. Could there have been a better illustration of the essential character of the electric central station industry?

A Study in Theater Lighting

THE architect and the illuminating engineer often get squarely at odds in important lighting work. The former has small regard for efficiency, sometimes, too, for adequancy, while the latter not infrequently is oblivious of harmonious effect. Now and then, more and more we are glad to say, they really get together and produce very interesting results. An example of such coöperation is exhibited in L. D. Morgan's account of the illumination of a new theater in Milwaukee. The striking feature of the design is that the whole lighting scheme is indirect, and the colors used in decoration were planned not only to harmonize but to do so without too great loss of efficiency as diffusing surfaces.

Perhaps the most interesting item is the use of what may be described as an indirect chandelier for the illumination of the main body of the auditorium. It is a gracefully modelled affair fully twelve feet in diameter and carrying 24 lamps, eighteen of 500 watts, the rest of 200 watts. In addition there are three 500-watt reflector lamps concealed in it for lighting the proscenium arch while a group of small lamps hidden below it serve to light the structure itself, thus relieving the darkening effect that would otherwise be inevitable. The lighting of the galleries and foyer is carried out with indirect fixtures of the more usual

kind suspended by single rods while more decorative designs appear elsewhere. The whole design appears to be beautifully consistent. It would be interesting to learn the actual energy provided for the various areas, so as to gain some idea of the real coefficient of utilization reached, merely as a matter of engineering interest. In a place like this efficiency is, to tell the truth, a secondary consideration since the cost of energy for lighting is a very trivial proportion of the overhead expense. The whole design is most interesting as an especially complete example of carefully studied indirect lighting.

The amount of new industrial and mercantile building construction now under way in America despite the drawbacks of the labor situation affords the best possible evidence of the fundamental soundness of our affairs. While thousands display unrest and indifference as the war fever subsides, millions more are working steadily and thus are keeping out of the newspapers. In planning for the future let us not make the mistake of considering the exceptional situation to be universal.

Oil Well Pumping With Induction Motors

AS TIME has gone on induction motors have gradually elbowed direct-current machines out of the road in many paths in which the latter hitherto maintained supremacy. The first accusation against the induction motor was that it could not start without excessive current. The second that it demanded abnormally high current all the time whether starting or running. The third that it had invariable speed. If one stops to consider a moment, speed variation in electric motors involves a rather high degree of specialization whatever the type of machine or the nature of the operating current. A series direct-current motor can be subjected to speed regulation by a series resistance, involving considerable loss of energy if the variations are to be wide, or by some species of commutation leading to considerable complication in the controller, as was the case in the early street car motors. In neither case will it hold a uniform speed at varying load at any point of its regulation. The shunt-wound direct-current motor is essentially a constant-speed machine, capable of being varied over a fair range by field commutation with its accompanying requirements of very liberal size and extra precautions against possible sparking. Even so the performance is not equally good at the high and low speeds and where a large variation is required, in the ratio of say 2 or 3 to 1 with heavy loads and good regulation at each speed, one is driven to still further complications in the way of multiple-voltage supply, or in some cases to Ward-Leonard control or something very like it. With the induction motor the case is very similar. One can get perfectly smooth regulation by a rheostatic control of the secondary or to a limited extent by increasing the slip through lowered primary voltage. In case of necessity one can do better than with any ordinary direct current arrangement by changing the number of poles in the induction machine as is done for instance in electrically driven ships.

In our current issue W. G. Taylor gives a very interesting instance of meeting the requirements of large speed variation in oil-well pumping. For this purpose induction motors proved highly desirable. In the various operations connected with working oil wells a considerable variation in speed is necessary. One motor now furnished for this purpose has a stator wound for either six-pole or twelve-pole operation. By providing the rotor with a simple drum controller putting resistance in the secondary, either speed permits of a reduction of 50 per cent while still giving full-load torque. That is, a machine will operate from 1200 r.p.m. down to 300 with ample flexibility of control, and two of the speeds, 1200 and 600 are highly efficient since they require no armature resistance. With a motor of this kind protected by a circuit breaker having automatic under-voltage and inverse-time-limit overload releases, it is quite easy fully to meet the speed requirement of an oil-well drive. The severity of the work is relieved by counterbalancing the walking beam which is a regular part of oil-well pumping equipment, so that not only are the variations in current reduced, but the load is relieved to the extent of actually reducing the consumption of energy by no inconsiderable amount.

Better records of interconnection results are needed in order to press the advantages of energy interchange to their economic limit. Load plots and plant performance graphs should supplement the drab "bought and sold" records of the accounting department, otherwise water and fuel may be wasted, unit labor costs increased and equipment handled in amateurish fashion.

Changes in Transmission Lines

A VALUABLE study of distribution economics is that presented in the current issue by Messrs. Reyneau and Seelye. The concrete problem investigated is reconstruction for the purpose of shortening lines with due regard of the possible value of material displaced. The condition is one which arises not infrequently, especially where there have been radical changes in the distribution system, as for instance, those due to the establishment of new stations or substations. In the last analysis economy of change requires that the added cost due to the constructorial changes shall be at least offset by the lessened losses of energy. The writers starting from this basis work out the necessary formulas for carrying out the needful computations. These as in the case of formulas for maximum economy of a transmission line involve many quantities to be estimated and given their proper values for the case in hand, and they will then lead to a definite result, based on the above criterion.

The chief difficulty in applying any such formulas whether for old or new lines lies in the difficulty of correct assumptions of value in advance of the work, and, even more generally, in the fact that the result is rigorous for only one epoch, that for which the working values of the variables are assumed. For example, a transmission line designed for maximum economy in 1914 will now vary far from the best result as of 1919, and in 1925 the situation will be still different. It takes, therefore, besides correct formulas, something very like the prophetic instinct to judge the probable economics of the situation over a term of years. To one with the necessary judgment and experience the methods here sketched out will prove extremely useful. They are worked out with a thoroughness and care that leaves little to be desired and the practical examples studied

are thoroughly typical of the situations which turn up in actual practice, and concerning which definite decisions have to be made.

Expansion of service by a public utility or manufacturer adds to the liability account for the time being, but when directed by farsighted brains the "turnover" will generally be found to warrant the undertaking. In electric service we seem always to be standing on the threshold of a new era, and those who have combined faith and courage in the past have often reaped their due rewards.

Thermal Conductivity of Underground Ducts

IT HAS been said that refinement in power-plant design has reached a state far in advance of distribution and transmission-line development. In the matter of conduit systems for underground cables, for example, there appear to be no data regarding the thermal conductivity of duct materials in common use. It is with pleasure, therefore, that we present this week an article by W. S. Wilder giving pioneer experiments on the thermal conductivity of underground duct materials. As pointed out by Mr. Wilder, the cross-section of underground cables for a given load and temperature rise will vary in nearly inverse ratio to the conductivity of the duct material, neglecting the effect of the concrete and other items. This assumption, of course, may not approximate the fact, but it is, nevertheless, of great importance to determine experimentally just what effect the duct material does have on the current-carrying capacity of underground cables under common operating conditions.

Although the data presented in this paper indicate that one duct material may have a considerably higher conductivity than another, the results can scarcely be considered conclusive. Their value lies more in the fact that they point out the need for investigation of this subject and give a general method of experimental procedure. This matter should receive the attention of engineers responsible for extensive underground systems where test data may be secured under actual operating conditions.

"More light for the same money," "It's not the light you use, but the light you waste, that causes high bills," "Learn to read your own meters," and other slogans have driven home to millions the thought of cost in connection with things electrical. This is all right so far as it goes; but with it should go a positive sales psychology based on the idea of convenience.

Ventilation of Induction Motors

IN THE early days of electric machine design attention had to be concentrated on securing output, and the internal losses in those relatively small machines necessarily received scant consideration. The main endeavor was to provide a machine which would give the required power. As a consequence the internal losses were apt to reach large values. Before the rotor core bodies were laminated some of them ran very hot, as may well be surmised from modern knowledge of the subject. It was soon found that the size of the internal losses began to limit output. Attention had then to be bestowed upon reducing the losses. A great step forward was taken in laminating the steel undergoing cyclic magnetization. This enabled larger machines to be built, and the difficulty of dissipating the heat loss then soon made itself disagreeably felt. Another great step was taken when the rotor was hollowed and ventilating ducts were provided in its surface, so that heated air could be thrown out radially, during rotation, by centrifugal force. This was probably the first great advance in forced ventilation.

During recent years, with increasing outputs and consequent increased internal losses, the dissipation of the heat by means of simple ventilating ducts has proved insufficient, and more powerful means of forced ventilation have had to be provided. In some large machines elaborate ventilating systems have had to be designed and constructed. Whereas in the early machines radiation was principally relied upon to dissipate the heat, now radiation plays a relatively small part in the process. Forced convection is the main source of cooling. The importance which proper ventilation has assumed in modern high-speed induction motors was pointed out by Fraser Jeffrey in an article appearing in the ELECTRICAL WORLD for Nov. 29-Dec. 6, page 988. It will be noticed that in the case of a 1000-hp. motor the steady dissipation of 35 kw., under rated load, requires about 2 cu.m. of air per second to be driven through the carcasses of the stator and rotor. This means, of course, that such a machine is a great air heater when in full operation, and it would not be surprising to find that this byproduct of electric power generation may be utilized commercially for supplying warm air to buildings. Electric-railway tunnels and subways to-day receive their needed warmth in winter from the heat rejected by the traveling motors.

Should this period in which the industry is chronically oversold continue for a long time salesmanship will become a lost art. Sales wits are already losing their vigor for lack of exercise. Some salesmen realize this and are keeping in trim for the day ahead when a buyers' market must again prevail.

Deterioration of Lighting Deserves Attention

DETERIORATION in illumination from using lamps beyond their useful period of life or from not paying enough attention to the accumulation of dust and other substances on reflecting surfaces is quite generally overlooked, and yet the expense of preventing it is more than offset by the results obtained. The second cause of deterioration in lighting is really the most serious.

While the average light output of the gas-filled lamp during its life is less than 5 per cent below the initial output, four weeks of lack of attention to reflectors will cut down the lighting from 10 to 25 per cent and sometimes nearly double even the last amount.

Attention to cleanliness, therefore, saves useful light to a very marked degree. Lamps neglected may be actually running at a virtual efficiency fully a third below the normal figure. To take account of the practical depreciation even when fixtures are cleaned once a month, Ward Harrison and H. H. Magdsick have made use of a depreciation factor of from 1.2 to 1.4. This enters very simply into the calculation of the total lumens required, and its use will insure maintenance of good lighting for reasonable periods between "cleans."

Artistic and Utilitarian Theater Lighting

Architects, Illuminating Engineers and Contractors Jointly Study Lighting of Vaudeville Stage in Milwaukee and Apply Harmonious Combination of Ideas Through Use of Concealed Light Sources

BY LYMAN DAY MORGAN

ARCHITECTS have long bemoaned the fact that the average electrical illuminating engineer is likely to view lighting work solely as a technical problem. This tendency, architects believe, influences the engineer to overlook all other considerations in favor of purely utilitarian lighting. An architect of national prominence remarked: "That electrical fellow's idea of a building is merely a structure to house lighting equipment." When the engineer was informed of this he made the criticism of the architectural profession in general: "Those fellows design very beautiful interiors and then sometimes ruin them by hiding all of their work back of a lot of wrought-iron holders for glaring light spaces." Both of these mutual critics were more or less right. The result was that up to ten years ago it was extremely rare to find an interior artistically treated as far as lighting results were concerned. This was especially true of theater auditoriums. Architects spent months in planning minor details to bring about a thoroughly harmonious and artistic treatment in the interior decoration of theaters and then hid these effects behind rows of bare lamps or immense chandeliers which ruined the very effects that they were striving for. Illumination can be treated simultaneously from the utilitarian and the artistic standpoint if architect and engineer can get together early enough in the planning of the interior.

FIG. 1—MAIN FIXTURE LIGHTS AUDITORIUM AND IS ITSELF LIGHTED BY AUXILIARY LAMPS

The illumination of the Palace Theater at Milwaukee affords one instance in which this work was taken into as much consideration in the original planning of the building as was the structural steel. It was not left until the last minute, as is too often the case in buildings of this kind. The results, which are shown in some of the accompanying pictures, really speak for themselves. It appears important, however, to point out some of the problems involved, since this is one of the most modern theaters in the Middle West and is said to be the largest in that section devoted exclusively to vaudeville.

LIGHTING FOR VAUDEVILLE STAGE SHOULD BE FLEXIBLE

Where a theater is to be used for one purpose, such as the presentation of motion pictures, illumination is a comparatively easy problem. However, diversity of program, such as opening with motion pictures and possibly closing with a drama, with a monologist sandwiched in between, requires great flexibility of illumination. The combination of various conditions has been met at the Palace Theater by the use of concealed sources entirely. To accomplish this the architect had to plan his interior so that the ceiling could be used as a diffusing surface, which, of course, meant the use of a light color in order to keep down the consumption of energy. It was not necessary, however, to have a white ceiling and light-buff side walls. Colors were so combined that wherever one having a low coefficient of reflection was used another with a high coefficient of reflection was worked in to balance the loss.

The decorative treatment in the theater has been described as "lavish" by interior decorators. Combinations of white, golden brown, orange, blue and black have been so successfully made that no one is conscious of an attempt to handle the color treatment from anything but the artistic standpoint. The decorative treatment, however, is so handled that, notwithstanding the high color absorption of the deep orange and blues, the indirect lighting is hardly less efficient than a direct-lighting scheme of the same intensity would have been. There is not an unconcealed light source in the entire

auditorium nor on the stage. The architect has even provided footlights so carefully designed that from the last seat in the gallery their glow is not objectionable.

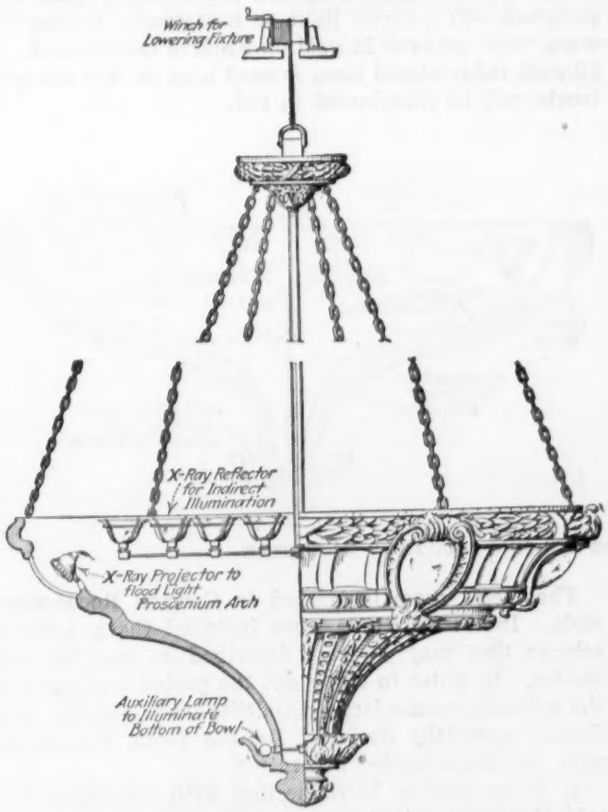

Winch for Lowering Fixture
X-Ray Reflector for Indirect Illumination
X-Ray Projector to Flood Light Proscenium Arch
Auxiliary Lamp to Illuminate Bottom of Bowl

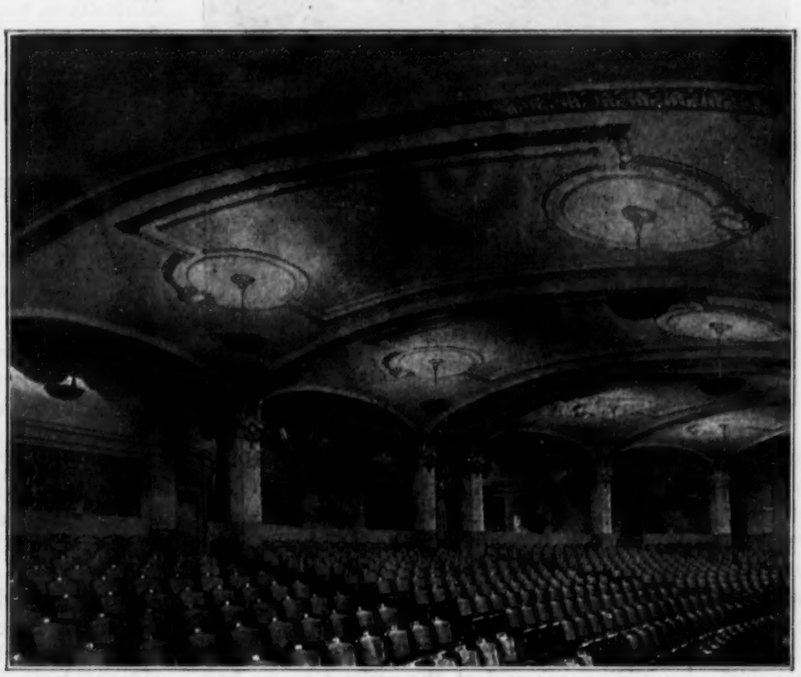
FIG. 2—PANELS THROUGH WHICH LIGHT IS PROJECTED ON THE PROCENIUM ARCH

The outer lobby, in order to attract the passer-by, is brilliantly illuminated by direct lighting. From this lobby a long foyer extends to the inner one. In order that the eye may accommodate itself to the change from daylight to the relatively dim illumination in the inner lobby the intensity is graduated. A 20 ft.-candle intensity is provided in the outer lobby and approximately a 5 ft.-candle intensity in the inner. The auditorium, when all lamps are burning, has an intensity of about 5 ft.-candles. This can be dimmed to less than 0.01 ft.-candle, which gives sufficient light for finding seats during the performance without interfering with the projection of motion pictures.

DESIGN OF LARGE CEILING FIXTURE

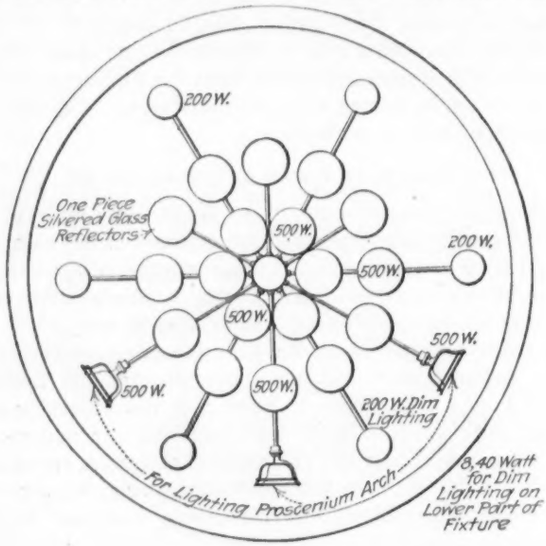
A single balcony extends to about the center of the auditorium. The upper section of this balcony—in fact, the entire auditorium with the exception of a small section of the rear—is illuminated by a single composition fixture of unique design. It is shaped somewhat like an inverted cone, is 12 ft. (3.6 m.) in diameter and 8 ft. (2.4 m.) deep. It weighs approximately 3600 lb. (1630 kg.). In order to overcome the objection to a huge indirect lighting fixture, dark on the under side, seen against a brightly illuminated ceiling, a small bowl 40 in. (100 cm.) in diameter was placed at the apex of the cone. Eight 40-watt lamps installed in this smaller bowl illuminate the lower surface of the fixture to about the same intensity as the ceiling. At the same time these small lamps provide sufficient illumination for finding seats when pictures are being shown. These lamps are connected with an emergency circuit and burn during the entire performance. Three 500-watt units are concealed back of three glass-paneled cartouches in the periphery of the fixture to project light through the panels and illuminate the proscenium arch.

On account of the size of this fixture it was necessary to build it in three parts to get it through the doors. It has a steel framework carrying a composition material applied to metal lath. After the three parts were assembled and bolted together the seams were painted with plaster of paris. Huge hand winches, permanently installed over the auditorium ceiling, raise and lower the fixture for cleaning and lamp renewals. To further facilitate the renewal of the lamps a ladder and a trap door above the fixture have been provided, so that it is

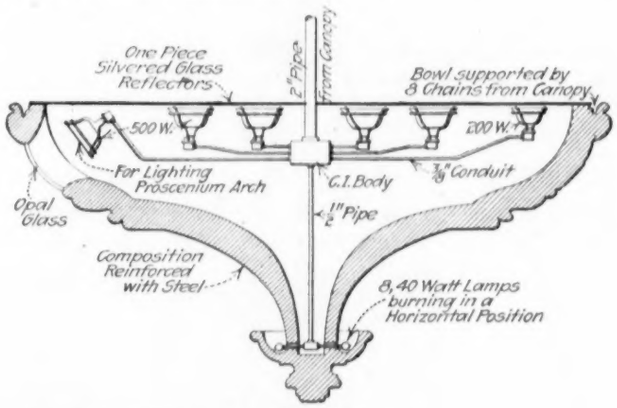


FIGS. 3 AND 4—ARCHITECTURAL DETAILS EMPHASIZED BY PROJECTED LIGHT; FLOATING-FIXTURE EFFECT UNDER BALCONY

not always necessary to lower it. The lighting equipment of the fixture is shown in the line drawing. There are six 200-watt units and eighteen 500-watt units.



monize with the indirect-lighting scheme as well as the general color effect. Where the city ordinances required certain light sources which would have been in the range of vision, a special low-intensity unit was designed, which threw light on a cartouche having the word "out" lettered in gold on a white background. A 10-watt ruby-colored lamp is used here so that the cartouche will be illuminated in red.



FIGS. 5 AND 6—DETAILS OF DESIGN FOR LIGHTING EQUIPMENT IN FIXTURE

Separate switches to provide flexibility of light are installed on the stage.

LIGHTING UNDER BALCONY, IN FOYERS AND ON STAIRS

Underneath the balcony and in both the upstairs and the main foyers indirect lighting units with four 100-watt gas-filled lamps, burning horizontally in an especially designed horizontal reflector, furnish the illumination. Fixtures under the balcony are supported by a single rod, giving the appearance of floating fixtures and eliminating any "fixture-showroom" effect. The same design is used in the foyer, but there the fixtures

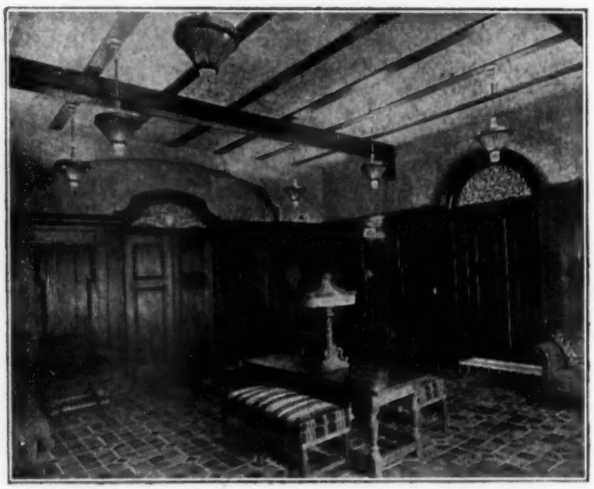


FIG. 7—MEN'S ROOM WITH INVERTED SILK-SHADE FIXTURES

are supported by four rods from the ceiling. Heavy opal-glass hemispheres illuminate the passages and stairways. The lighting of the treads of the balcony stairs is from an indirect source in the side walls, with baffleplates so arranged that the light cast on the stairs causes the treads to be seen in silhouette rather than by direct illumination.

All exit lights have been carefully designed to comply with city ordinances and at the same time to har-

The men's room is treated in German Renaissance style. Indirect fixtures were installed there, using a scheme that may be best described as inverted silk shades. In order to carry out the period treatment in the women's room a large chandelier was installed. This fixture, especially designed for the room, harmonizes with the Adam period decoration.

It is noteworthy in connection with the entire illumination scheme that there is not a non-standard lamp used in the theater. Any dealer, therefore, can supply lamps for renewals upon short notice and the theater is not forced to carry a large stock.

The theater was designed and planned under the personal supervision of Mr. Rose, of Kirchoff & Rose, Majestic Building, Milwaukee. All of the electrical work was conducted by George F. Rohn, electrical contractor, Milwaukee, who also supplied the lighting fixtures. The fixtures were designed by Wilmer E. Snow, of the National X-Ray Reflector Company, Chicago, under the supervision of Mr. Rose.

PLASTIC FIRE BRICK MADE IN POWER PLANT

Life of Brick Work Increased 30 per Cent. by Use of This Plaster for Surfacing and Repairing Boiler Furnace Walls

Nearly 30 per cent is added to the life of boiler walls and furnace arches in the station of the Indianapolis Light and Heat Company by the use of inexpensively made plastic fire brick. The plaster is made as follows: Four parts of coarsely ground fire brick, one part of broken-up asbestos, and one part of fire clay, are mixed with a saturated solution of salt water to form a thin dough. After it has stood for 24 hours, and then has been thoroughly worked, it can be applied to the bridge, side walls and arches so as to form a smooth covering and stop any holes. By careful inspection and timely use of this plaster a considerable saving of money for brickwork is effected.

Transmission-Line Reconstruction

Methods and Economic Principles Involved in Analyzing the Cost of Improvements, Rebuilding, Replacement and Other Similar Problems on Transmission Lines—Utilization of Old Materials

BY P. O. REYNEAU* AND H. P. SEELYE

IN THE Dec. 27, 1919, issue of the *Electrical World* the authors presented a general method of analyzing the cost of reconstructing a transmission line where the material to be displaced was still serviceable. In this issue it intended to show how this general method can be applied to a few specific problems, namely shortening a line already in service, using part of old equipment in its original location, and choice of transmission route.

Economy of Shortening a Line

Assume, for example, a line several years old which is in good condition and of sufficient capacity to care for the predicted load up to the probable length of its life. Since its construction, however, conditions have so changed that it is now possible to reduce its length considerably by using a more direct route in some places. The question arises whether or not it would be economical to rebuild those portions of the line by the shorter routes. In order to determine this it is necessary to compare the annual cost of the present installation with the total annual cost chargeable to the reconstructed installation if the change is made. These annual costs may be determined by use of the general equations previously developed.

The present annual cost charged to the section of the line under consideration is:

Annual cost of old line =

$$g \left[\begin{array}{l}\text{cost of material in old line} \\ + \text{cost of labor in old line}\end{array}\right] + \text{cost of superintendence, repairs, patrolling, etc.} + \text{cost of energy loss in old line,}$$

where g represents the percentage to be charged each year against the total investment for interest, taxes, insurance and depreciation. As explained before, g is different for the different items, depending on their characteristics and term of life. The expression "$g \times$ (any quantity)" merely indicates that it is the annual charge against that quantity which is being considered.

The annual cost in case the old line is replaced by the new section would be:

Annual cost of reconstructed line =

$$\left[\begin{array}{l}\text{present value of labor in old line} \\ + \text{cost of material in new line} \\ + \text{cost of labor in new line} \\ + \text{cost of labor removing old line}\end{array}\right] + \text{cost of superintendence, repairs, patrolling, etc.} + \text{cost of energy loss on new line.}$$

It would be economical, then, to undertake the new construction only if the annual cost of the reconstructed line, thus computed, is less than that of the old line. The added construction cost must be offset by the reduced energy loss. The limiting case is when the two annual costs are equal—

Annual cost of reconstructed line = annual cost of old line.

It is evident, however, that several of the items in both annual costs are practically the same, so for the purpose of this comparison they may be eliminated. Since the reconstructed section is but a small part of the line as a whole, its useful life must be assumed to be that remaining in the old line. Hence the annual charges against the "present value of labor in old line," which is part of the "annual cost of the reconstructed line," will be practically equal to the annual charges against "cost of labor in old line," which is part of the "annual cost of old line." The cost of "superintendence, repairs, patrolling, etc.," will be practically the same for both, unless the difference in length is large. The equation then reduces to

$$g \left[\begin{array}{l}\text{cost of material in reconstructed line} \\ + \text{cost of labor in reconstructed line} \\ + \text{cost of labor removing old line}\end{array}\right] + \text{cost of energy loss on reconstructed line} = g\,(\text{cost of material in old line}) + \text{cost of energy loss on old line}$$

The cost of material and labor in the new line will, of course, include the cost of any private right-of-way which it is necessary to purchase and of any other extra expense connected with the construction.

A system of symbols will be adopted, conforming to those used in the article referred to at the beginning of this discussion.

Let L_n = length in miles of the new section to be built.
L_o = length in miles of the old section to be replaced.
kw. = load in kilowatts.
L_r = the length in miles of right-of-way to be purchased.
N = number of new corners necessary in reconstructed line.
C_r = cost per mile for right-of-way.

The details of the computation of unit costs used here need not be given as they would apply to only one particular case. The figures used are based on a line at 46,000 volts, single construction, on wooden poles, with No. 0 bare copper wire, energy costing 1 cent per kilowatt-hour. The annual cost on such new construction introduced into an old line will vary somewhat with the age of the line as explained above. However, since such a reconstruction would probably not be considered except during the early life of the line, and, of course, the shorter the remaining useful life assumed the greater the salvage value of the new material at the end of that life, this may be assumed to be constant for any age. This assumption would also be favored by the probability that this new section would be used, at least in part, beyond the life of the rest of the line.

The unit costs are then assumed to be as follows:—

Annual charges on material and labor in reconstructed line, per mile	$360.00
Annual charges on cost of labor, removing old line, per mile	30.00
Annual charges on cost of material on old line, per mile	225.00
Annual cost of energy loss, per mile	0.69/10⁶ kw.²
Annual cost of new corner	40.00
Annual cost of right-of-way, per mile	0.08

*Distribution engineer the Detroit Edison Company.

Substituting these values, the equation for determining economy becomes:

$$360L^2 + 40N + 0.08C_rL_4 + 30L_0 + (0.69 \text{ kw.}^3/10^5)\ L_2 = 225L_0 + (0.69/10^5 \text{ kw.}^3)\ L_3$$

$$165L^2 + 40N + 0.08C_rL_4 = (L_0 - L_3)\ [0.69/10^5 \text{ kw.}^3 + 195] \quad (1)$$

There are too many variables to exhibit this equation as a curve. The limiting values, however, can be so expressed. If no right-of-way need be purchased and no new corners are added, the greatest length of a new line, L_3, in order to effect a saving of one mile ($L_0 - L_2 = 1$) would be

$$\frac{L_2}{L_0 - L_2} = \frac{0.69/10^5 \text{ kw.}^2 + 195}{165} = \frac{0.418 \text{ kw.}^2}{10^7} + 1.18. \quad (2)$$

This is plotted in curve *A*. This curve shows the greatest length of new construction which could be economically built under the most favorable conditions; that is, normal line construction cost with no corners and no other extra expense for right-of-way, etc., for each mile subtracted thereby from the total length of the line. If such other extra expense is necessary, the value of $L_3 / (L_0 - L_2)$ will be less, as may be seen from the equation (1). Hence this curve may be used as a test. If the length of new line under consideration is greater than that shown by the curve, it will not be economical to build it. If it is less, the exact economy must be determined from equation (1). For example, as a rather extreme case, suppose there are extra corners necessary and the total distance, L_3, will be on private right-of-way costing $35 per mile per year:

$$\frac{L_2}{L_0 - L_2} = \frac{0.345 \text{ kw.}^2}{10^7} + 0.975 - \frac{0.2N}{L_0 - L_2}. \quad (3)$$

If the last term is omitted, this equation may be plotted as shown by the curve B, and gives the economical values of $L_3 / (L_0 - L_2)$ (new construction per mile saved) when the extra construction cost is fairly large. For extra corners $0.2/ (L_0 - L_2)$ miles must be subtracted from the value shown by the curve for each additional corner. Of course, there might be other extra costs for more poles, higher poles, etc., which have not been especially constructed here. These could be included in the same manner, however.

The economy for any particular loading on such a line may now be readily discovered from the curves and equations. If, for example, under the conditions assumed, the load is 6000 kw., for no corners and no cost of right-of-way, according to curve A, the new construction could be built for 2.7 miles (3.3 km.) for each mile saved thereby, or, say, 8.1 miles (13 km.) in order to save 3 miles (4.8 km.) In case the new construction requires private right-of-way, as per curve B, 2.2 miles (3.4 km.) may be built for each mile saved, or 6.6 miles (10.4 km.) to save 3 miles. If two extra corners were necessary, the figure would be 1.8 miles (2.5 km.) for only 1 mile (1.6 km.) saved, or for 3 miles, 2.067 per mile, or 6.2 miles (9.9 km.), and so forth.

There is thus displayed a tangible method of exhibiting the economy of shortening an old line by reconstruction. For any particular system, of course, the costs must be derived independently. From them similar curves can be drawn and applied to the solution of such problems.

Another characteristic problem of this general nature is the following. In building a new line to replace an old one which is not worn out it may be possible to use a considerable length of the old line poles or other materials in place. However, some shortening of the length of the line might be accomplished by using a more direct route on entirely new construction. How far from the direct route may the line diverge economically in order to use this old line material?

The solution is again reached by a comparison of the annual costs on the two routes using the general equation already developed. This comparison, however, may be considerably simplified, as in the preceding problem, by making use of certain short cuts which reduce the number of terms to be considered. The "present value of labor in old line" is a cost chargeable to the reconstructed line as a whole. It will be the same no matter whether the old material is used in place or not. Hence it may be omitted in the comparison of economy of the two methods of construction on any section of line where the use of old material is considered. The "cost of labor removing the old line" is also chargeable to the new line as a whole, and it might be somewhat difficult to apportion properly the amount to be charged to any particular section. This may be avoided if it is considered, for the comparative costs, that this item is the same amount for both alternative constructions and hence may be omitted from both. Since, however, some of the old material left in place will reduce the actual amount of this item in the one case, the cost represented by the old materials used must be adjusted by subtracting from their present value the amount which it would have cost to remove them. It is seen that this method is equivalent to charging both alternatives with the proper share of the "cost of removing old line" and then subtracting from one the removal cost eliminated by the use of the old material in place. It is also equivalent to considering that old material in place should be charged at its warehouse value, which is its present value as material, if available, less the cost of making it available or removing it to the warehouse. The adjusted annual costs of the reconstructed line on old poles, and of new construction, per mile may be thus obtained and are convenient figures to use in all such economic comparisons. It must always be borne in mind, however, that these are adjusted costs and are not the true annual costs chargeable to the line.

The comparison of the annual costs of the two routes may now be made by comparing the values obtained from the expression

$$g\ [\text{cost of material and labor (adjusted cost)}] + \text{cost of energy loss},$$

with the proper selection of g, for both alternatives.

The following symbols have been used:

L_1 = length in miles of the old pole line which can be used.

L_2 = length in miles of the alternative new line.

L_3 = length in miles of the new construction necessary to supplement the old pole line, i.e., bringing the line from the new route to the old if necessary.

N = the number of new 90-deg. corner constructions saved by using the more direct route.

kw. = load carried in kilowatts.

a = age of old pole line in years.

C_e = cost of energy per kilowatt-hour.

L_4 = length, in miles, of right-of-way to be purchased.

C_r = purchase price per mile of right-of-way.

The figures here given are based on an old line on untreated wood poles, new line on treated poles; voltage of reconstructed line 46,000 volts, necessitating new cross-arms and insulators throughout; wire No. 0 bare copper on both old and reconstructed lines.

The annual charges obtained under these conditions are as follows:

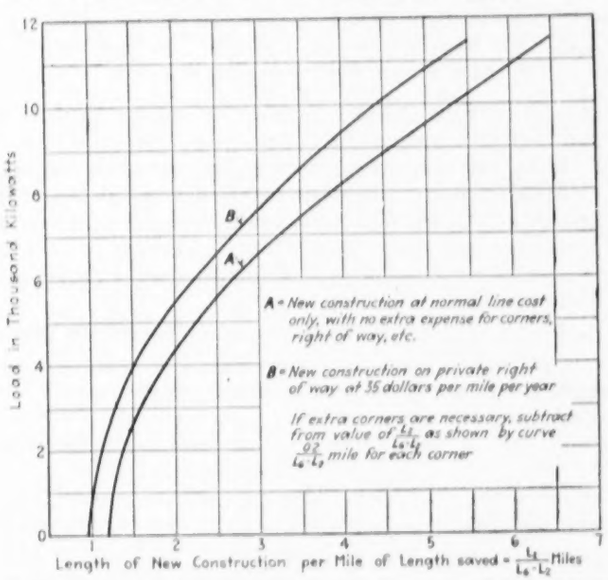
Annual charges on new construction, per mile... $350
Annual charges on reconstruction on old poles, per mile..... $(3350-260a+3.2a^2)/15-818a$
Annual charges on energy loss..... $\frac{69}{10^6}$ kw.^{2} Ce
Annual charges on corner construction..... $38

It is now a question of whether the annual cost on $L_1 + L_2$ is greater or less than on L_3 using the above figures. It would be advantageous to divert to the old pole line when

$$L_1\left(\frac{3350-260a+3.2a^2}{15-a}+\frac{69\text{ kw.}^2\,C_e}{10^6}\right)+L_2\left(350+\frac{69\text{ kw.}^2\,C_e}{10^6}\right)+38N<L_3\left(350+\frac{69\text{ kw.}^2\,C_e}{10^6}\right).$$

$$L_1<\frac{(L_3-L_2)\left(350+\frac{69\text{ kw.}^2}{10^6}C_e\right)-38N+0.08\,L_4C_r}{\frac{3350-260a+3.2a^2}{15-a}+\frac{69\text{ kw.}^2\,C_e}{10^6}} \quad (4)$$

An example of the use of this equation would be in such a case as that of a line following a private right-


Load in Thousand Kilowatts
Length of New Construction per Mile of Length saved = $\frac{L_4}{L_4-L_2}$ Miles
B = New construction on private right of way at 35 dollars per mile per year
A = New construction at normal line cost only, with no extra expense for corners, right of way, etc.
If extra corners are necessary, subtract from value of $\frac{L_2}{L_4-L_2}$ as shown by curve $\frac{92}{L_4-L_2}$ mile for each corner

MAXIMUM ECONOMICAL LENGTH OF NEW LINE THAT CAN BE CONSTRUCTED TO REPLACE OLD LINE PER MILE OF LINE ELIMINATED

of-way instead of a highway, thereby eliminating four corners and considerable distance. If we assume the old line to be five years old ($a = 5$) and $C_e = 0.01$ and right-of-way at $35 per mile per year, the equation would become for that particular case with $L_4 = L_3$: $L_3 = 0$: $N = 4$:

$$L_1<\frac{L_2\left(350+\frac{0.69\text{ kw.}^2}{10^6}\right)-152+35\,L_2}{\frac{3350-1300+80}{10}+\frac{0.69\text{ kw.}^2}{10^6}}$$

$$L_1<\frac{L_2\left(385+\frac{0.69\text{ kw.}^2}{10^6}\right)-152}{\frac{0.69\text{ kw.}^2}{10^6}+213}, \quad (5)$$

which is easily solved for known values of L_1, L_2 and the load and the relative economy thus determined. If L_1 is greater than the second member, the economy evidently lies in the new route; if less, in the old one. No curve could be plotted which would be of any great value in this instance since there are so many variables in the expression which are fixed for only one particular problem or condition.

APPLICATION OF METHOD TO CHOICE OF TRANSMISSION ROUTE

There is a very useful application of the principles of this last problem in the choice of a route for a transmission line as a whole. When there are several alternative routes a condition similar to the following concrete example is very often encountered. Power was to be transmitted to a distance of approximately 30 miles (48 km.) from the central station. There were three routes available for the new line, no one of which had any evident marked advantage over the others. Each one included a different amount of private right-of-way, of old pole line, of new construction, of corners, and of distance over which the construction cost would be excessive on account of high trees and other obstructions. The comparatvie economy of the three routes was displayed, by use of the adjusted annual costs explained above, and tabulated as shown in the table:

ADJUSTED ANNUAL COSTS

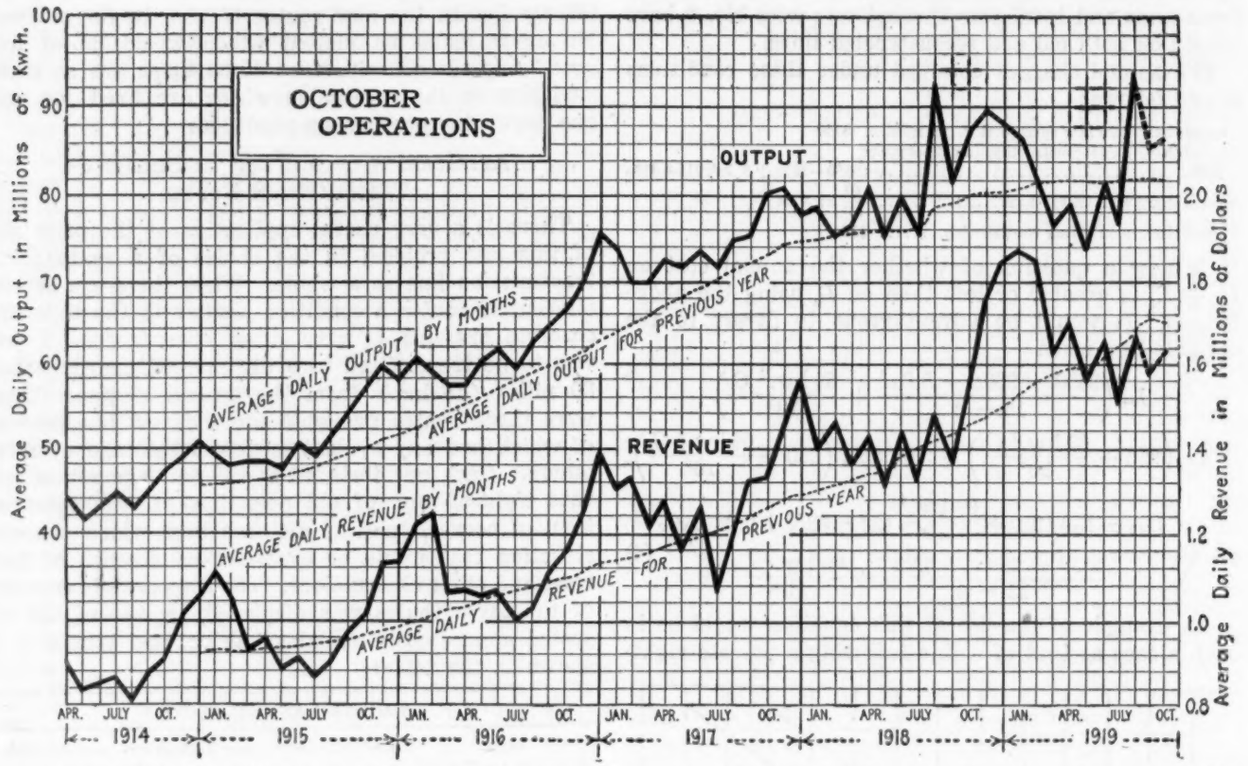
Item	Route A		Route B		Route C	
New construction at $350 per mile.....	21 miles,	$7,360	19 miles,	$6,650	22 miles	$7,700
Reconstruction on old poles at $213 per mile	8 miles,	1,710	12 miles,	2,560	6 miles,	1,280
Right-of-way at $35 per mile.....	6 miles,	210	4 miles,	140	10 miles,	350
Corners at $38 each...	Nine,	342	Seven,	266	Seven,	266
Energy loss, 4,000 kw. load at $110 per mile.	29 miles,	3,190	31 miles,	3,410	28 miles,	3,080
Difficult construction..	3 miles		2½ miles		3 miles	
Total.....		$12,812		$13,026		$12,676

It is evident that route C is the most economical even though it requires the purchase of more private right-of-way and uses less of the old pole line, since it is somewhat shorter and some corners are eliminated. The extra cost of difficult construction is rather hard to calculate without a detailed layout of the line. It can be estimated, however. In the instance under notice the amount of extra construction was so nearly equal in each case that this was not thought necessary.

As has been explained in previous articles on this subject, there are some other features of such a line that cannot be included in such a cost analysis and which might have considerable weight in the determination of a route. One route might be more accessible for patrolling and repairs than the others. The proximity to a railroad might effect the construction cost considerably. The shelter afforded the line against severe storms might be a large factor for consideration. These points can, however, be weighed against the advantage in cost alone, and the most advantageous route will usually be evident.

This points to the advantage of greater care in the selection of the routes for new lines in new territory even though at the time it may seem advisable, on account of light load, to keep the construction cost at a count of light load, to keep the construction cost down.

Output Increases Despite Strikes



A HIGHLY favorable rate of increase in central station production is indicated from the returns received by the ELECTRICAL WORLD for the month of October. The scale of increase which had its origin in March of this year is steadily advancing. On the basis of the figures received the estimate for the whole industry is: revenue, $50,500,000; output, 2,680,000,000 kilowatt-hours.

Although labor troubles were general throughout the country during October, tending to reduce production and indirectly reduce the power requirements of central stations, yet it appears probable that the usual seasonal increase in electric lighting requirements has overcome this reduction, giving a 6 per cent increase over a similar period for last year. A substantial increase in revenue is especially noticeable in the New England and Atlantic States.

During October there were 15,627,926 active cotton

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	Percentage of Industry Represented	New England States 1918	New England States 1917	Per Cent Increase	Percentage of Industry Represented	Atlantic States 1918	Atlantic States 1917	Per Cent Increase	Percentage of Industry Represented	Central States 1918	Central States 1917	Per Cent Increase	Percentage of Industry Represented	Pacific and Mountain States 1918	Pacific and Mountain States 1917	Per Cent Increase
REVENUE	Nov.	64	$3,695,000	$3,238,000	14.1	55	$11,877,000	$10,400,000	14.2	50	$9,277,000	$7,704,000	20.4	81	$5,034,000	$4,552,000	10.6
	Dec.	64	4,097,000	3,449,000	18.7	55	11,927,000	10,199,000	16.9	50	10,781,000	8,836,000	22.0	79	5,253,000	4,644,000	13.1
			1919	1918			1919	1918			1919	1918			1919	1918	
	Jan.	63	4,253,000	3,443,000	23.5	60	13,444,000	11,168,000	20.3	47	10,410,000	8,484,000	22.7	77	5,187,000	4,494,000	15.4
	Feb.	63	3,895,000	3,048,000	27.7	53	10,894,000	8,943,000	21.8	45	9,305,000	7,484,000	24.3	73	4,036,000	3,618,000	11.5
	March	64	3,608,000	3,044,000	18.4	58	11,731,000	10,244,000	14.5	47	9,012,000	7,447,000	21.0	81	4,218,000	3,685,000	14.4
	April	64	3,473,000	2,964,000	17.2	51	11,408,000	10,114,000	12.7	47	8,420,000	6,981,000	20.5	76	4,328,000	3,755,000	15.3
	May	62	3,194,000	2,800,000	14.0	51	9,430,000	8,571,000	10.0	47	8,297,000	6,888,000	20.4	77	5,468,000	4,764,000	14.7
	June	64	3,321,000	2,925,000	13.3	55	10,535,000	9,478,000	11.2	50	8,757,000	7,504,000	16.7	78	5,516,000	4,767,000	15.8
	July	61	3,329,000	2,949,000	13.0	50	9,319,000	8,375,000	11.8	50	8,854,000	7,442,000	18.0	79	4,214,000	3,756,000	12.3
	Aug.	64	3,579,000	3,192,000	12.2	59	11,401,000	10,490,000	8.3	49	9,469,000	8,260,000	14.5	79	5,415,000	4,930,000	10.0
	Sept.	64	3,705,000	2,285,000	16.2	63	10,619,000	9,380,000	13.2	41	7,407,000	6,530,000	13.4	79	5,313,000	4,530,000	12.8
	Oct.	63	3,603,000	2,929,000	22.9	56	10,646,000	8,877,000	20.2	37	7,315,000	6,470,000	13.0	65	3,674,000	3,360,000	9.3
KW.-HR. OUTPUT			1918	1917			1918	1917			1918	1917			1918	1917	
	Nov.	64	138,559,000	123,033,000	12.6	55	542,799,000	495,812,000	9.4	50	444,012,000	396,665,000	11.9	81	403,566,000	368,237,000	9.6
	Dec.	64	145,543,000	129,838,000	12.1	55	405,253,000	421,973,000	12.6	50	489,864,000	443,544,000	10.4	79	428,906,000	374,906,000	14.6
			1919	1918			1919	1918			1919	1918			1919	1918	
	Jan.	63	143,254,000	124,632,000	14.9	60	525,322,000	458,545,000	14.5	47	463,394,000	403,127,000	14.9	77	390,690,000	371,156,000	5.2
	Feb.	63	128,660,000	109,993,000	17.0	53	406,702,000	374,958,000	8.4	45	426,965,000	378,992,000	12.6	73	287,479,000	293,492,000	-2.0
	March	64	125,510,000	124,707,000	0.7	58	459,166,000	461,096,000	-0.4	47	442,591,000	423,802,000	4.4	81	330,714,000	331,769,000	-3.0
	April	64	123,211,000	118,322,000	4.1	51	382,282,000	369,701,000	3.4	47	373,116,000	345,213,000	8.1	76	328,925,000	333,405,000	-1.0
	May	62	120,949,000	122,531,000	-1.3	51	362,207,000	383,860,000	-5.6	47	389,805,000	375,944,000	3.6	77	382,637,000	385,543,000	-0.7
	June	64	127,355,000	119,946,000	6.3	55	406,102,000	417,441,000	-2.7	50	417,942,000	386,422,000	8.4	78	445,814,000	443,209,000	0.6
	July	61	139,133,000	129,639,000	7.4	50	373,105,000	378,053,000	-1.5	50	428,370,000	408,165,000	5.0	79	366,275,000	365,263,000	0.3
	Aug.	64	148,442,000	143,100,000	3.4	59	595,812,000	625,000,000	-4.8	49	470,475,000	445,000,000	6.0	79	444,026,000	465,518,000	-4.8
	Sept.	64	141,742,000	139,200,000	1.9	63	561,241,000	580,500,000	-3.3	41	330,934,000	295,100,000	12.0	79	411,551,000	412,282,000	-0.2
	Oct.	63	132,816,000	121,800,000	9.0	56	569,057,000	544,500,000	4.5	37	335,335,000	300,500,000	11.5	65	299,813,000	293,100,000	2.2

spindles in the New England States, an increase of 5.1 per cent over October of 1918. The labor troubles of one kind or another, however, were still under way in the textile industry tending to materially reduce the energy consumption of this industry. Prosperous conditions in other lines of industry and additional calls for current for illumination appears to have offset these adverse conditions.

October pig iron production was the smallest since February, 1915, and it will probably be some time before production reaches the level attained before the strike. Furnaces in blast on Nov. 1 had a daily capacity of 65,625 gross tons, as compared with 50,100 gross tons on Oct. 1, 1919, and 113,000 on Nov. 1, 1918. When the steel strike was at its strongest it brought production of steel down to about 50 per cent of normal. At the end of October production was about 60 per cent, or perhaps a trifle more. The Mahoning Valley, in Ohio, which represents about 10 per cent of the country's steel production, was closed tight until the middle of October, and at the end of the month production in this district was only about 15 to 20 per cent of its capacity.

The large silk mills of Pennsylvania were also seriously affected by strikes during the month and the textile industry in the neighborhood of Chicago was operating at not over 50 per cent capacity. Despite these industrial handicaps the utilities in the Atlantic and Central states showed a substantial increase.

The ship yard strike continued in full force on the Pacific Coast during October, but the effects were not sufficient to offset the increased call for power in Southern California and the copper regions, as well as the generally improved industrial conditions in Washington.

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Percentage of Industry Represented	Revenue from the Sale of Energy			Kw.-Hr. Output		
		1918	1917	Per Cent Increase	1918	1917	Per Cent Increase
Nov.	57	$29,883,000	$25,894,000	15.4	1,528,836,000	1,383,747,000	10.5
Dec.	56	32,058,000	27,128,000	18.1	1,539,161,000	1,369,542,000	12.3
		1919	1918		1919	1918	
Jan.	57	33,294,000	27,589,000	20.6	1,522,660,000	1,357,460,000	12.1
Feb.	54	28,130,000	23,162,000	21.4	1,249,806,000	1,157,275,000	7.9
Mar.	57	28,569,000	24,420,000	16.8	1,357,981,000	1,341,374,000	1.2
Apr.	54	27,629,000	23,814,000	15.9	1,278,273,000	1,240,842,000	2.9
May	55	26,389,000	23,023,000	14.6	1,255,598,000	1,267,878,000	—1.0
June	57	28,129,000	24,676,000	13.8	1,397,213,000	1,367,018,000	2.2
July	55	25,716,000	22,523,000	12.5	1,306,883,000	1,281,120,000	2.1
Aug.	58	29,864,000	26,590,000	12.7	1,658,755,000	1,672,000,000	—0.8
Sept.	56	27,044,000	22,870,000	18.0	1,445,468,000	1,380,900,000	4.8
Oct.	50	25,238,000	21,637,000	16.3	1,337,021,000	1,259,900,000	6.2

OPERATING DATA ON AN ELECTRIC BRASS FURNACE

Yellow Metal Melted with a Loss Less Than 1 per Cent—Effect of Sunday Closing on Furnace Economy

Although not operating under ideal conditions for the greatest economy, the 105-kw. Bailey brass furnace at the plant of the Hays Manufacturing Company, Erie, Pa., has consistently shown that the guaranteed production can be obtained without any trouble. However, as this plant operates only five and a half days each week, it cannot be expected that the furnace will work with the best economy possible. The melting period is from 6 a.m. to 3:30 p.m. for five days and from 6 a.m. to 9 a.m. on Saturdays. To insure efficient operation of the furnace during working hours, it is preheated between the hours of 3 a.m. and 6 a.m. on every week day excepting Monday. The furnace is started up at 11 p.m. on Sunday if it has not been opened for addition of resistor material. In this case an additional three hours of preheating is provided on Sunday. This is usually necessary every three weeks.

The yellow metal which is poured at 2200 deg. Fahr, (1200 deg. C.), is made up of 75 per cent copper, 4 per cent lead, 1 per cent tin and 20 per cent zinc. After having kept an accurate account for a period of two weeks of the metal charged and the metal poured, the Hays company found that the actual loss in metal was about 1 per cent after the first month of operation. In addition there is an absorption of metal by lining which may be lost temporarily but is regained when the temperature of the furnace is high enough to melt it. This accounts for a high kilowatt-hour-per-ton rate on one day and a small rate on another date.

Reference to the accompanying table shows the effect of the non-working period on the furnace economy. Between the time the furnace is shut off at 9 a.m. Saturday and when it is again started there will be some radiation. This necessitates preheating the furnace at a rate of 130 kw. for seven hours before starting up the beginning of the week and three hours before starting up on week days. The power input is maintained at 130 kw. at all times during the preheating and actual heating periods excepting during the charging and pouring intervals.

PERFORMANCE OF ELECTRIC FURNACE MELTING YELOW METAL

Date	Weight Charged, Lb.	Energy Used Kw.-Hr.	Kw.-Hr. Per Ton Charged
Tuesday, Sept. 2, 1919	6,180	2,568	803
Sept. 3, 1919	6,376	1,656	518
Sept. 4, 1919	6,344	1,608	510
Sept. 5, 1919	6,306	1,752	556
Sept. 6, 1919	3,010	1,032	688
Monday, Sept. 8, 1919	6,309	2,304	731
Sept. 9, 1919	6,343	1,632	511
Sept. 10, 1919	6,130	1,608	527
Sept. 11, 1919	6,335	1,632	511
Sept. 12, 1919	6,366	1,632	510
Sept. 13, 1919	2,062	720	686
Monday, Sept. 15, 1919	6,353	2,328	728
Sept. 16, 1919	6,343	1,560	495
Sept. 17, 1919	6,370	1,608	503
Sept. 18, 1919	6,045	1,464	488
Sept. 19, 1919	6,186	1,488	480
Sept. 20, 1919	2,456	912	729
Monday, Sept. 22, 1919	6,112	2,207	723
Sept. 23, 1919	6,032	1,488	496
Sept. 24, 1919	6,069	1,464	480
Sept. 25, 1919	6,064	1,560	511
Sept. 26, 1919	6,038	1,488	496
Sept. 27, 1919	2,389	864	720
Monday, Sept. 29, 1919	5,512	2,136	777
Sept. 30, 1919	5,443	1,320	489
Summary for month	139,173	40,032	575

During the period immediately preceding the month of September the method of operating was slightly different. Then the policy was to maintain the input at 105 kw. Much better economy is obtained by the present method and the product is considerably improved by the higher temperature obtained.

If the furnace were operated twenty-four hours a day for seven days, the efficiency would be greatly increased because the 400 kw.-hr. used for preheating each morning would be saved. However, the accompanying data give an idea of what can be expected of a furnace operating under working conditions which are typical of those in the present-day industrial plant.

Requirements for Induction Motor Service

Showing It Is Practicable to Require Only 125 Per Cent Full Load Current-Carrying Capacity in Spite of High Starting Current—Change in Code Suggested

THERE appears to be an opportunity to employ some common sense engineering to save the induction motor buying public from spending money needlessly. Rules for induction motor service leads now followed in some of the principal cities of the country are antiquated. They confuse the questions of protection against high starting currents with that of protection against overloads and they confuse the question of fusing with the question of wiring. This has resulted in the establishment of induction motor service requirements that are needlessly severe. Constructive thinking which has been done on this topic indicates now that economy without sacrificing safety is possible. Hence the economy is desirable.

To secure an accurate view of what this economy will mean, consider the various kinds of equipment and material installed between the mains and the induction motor under ordinary conditions. Beginning at the mains there are (1) fuses, (2) wire, (3) conduit, (4) elbows, (5) a knife switch, (6) a compensator, (7) conduit fittings and (8) connectors at the motor. Even a 25 per cent reduction in requirements would effect a substantial saving in the cost of considerable of this equipment, especially if the service is long and the motor large. It is the purpose of this article, therefore, to point out the practicability of adopting a standard service requirement of 25 per cent overload for the service installation.

The first step in the solution of this problem, in the opinion of V. H. Tousley, chief electrical inspector for the city of Chicago, is to separate the subject of fusing from that of the size of wires. In commenting on this Mr. Tousley said: "The fusing of an alternating current motor should be determined by the normal running current and should be regulated as follows: (a) by the starting fuse if such fuse does not exceed the normal running current by a certain specified amount, this value to be somewhat below the maximum current at which such motor may operate for an indefinite time; (b) by running fuses, or, in lieu thereof, overload releases on motor starting boxes; (c) by time-limit circuit breakers or relays.

"The size of wire should be determined solely on a basis of the normal running current and without regard to starting currents, the wire to be of a size to provide for 125 per cent of the normal running current of the motor.

"In order to devise a wiring table based on this rule it will be necessary (1) to classify motors into groups according to their horsepower, using groups where the characteristics fundamental to the table are somewhat similar; (2) to classify motors into groups where the combined efficiencies and power factors are similar."

Agreeing in this general program is F. A. Barron of the General Electric Company who said: "The first step in the solution of this problem is to separate the question of starting fuse capacities from that of copper capacities for the reason that starting fuse capacities are fixed by their overload time lag and ability to carry the momentary starting current of the motor without melting. It seems impossible to avoid a certain amount of over fusing, especially in motors which have two current capacities so far apart as in motors of the induction type, therefore we feel strongly that the fine print note table in rule 8-c National Electrical Code should be retained for fuses and the explanation therein should be changed to refer to fuse capacities instead of wire sizes.

"We believe also that the capacity of copper for branch circuits of induction motors may safely be figured on about 125 per cent of the motor name plate rating and selected from table A, rule 18, National Electrical Code, especially if potential drop in branch circuits is also included in the copper capacities."

Another substantiating point of view comes from S. Glen Vinson, secretary and general manager of the Ideal Electric Company. He said he believed the present underwriter's rules covering induction motor installation would benefit by changing and standardization, and continued: "Ordinarily, a motor is figured for an overload maximum of 25 per cent; the conductors are practically all concealed and are figured on temperatures from 40 deg. C. to 55 deg. C., whereas open wiring or service lines are figured on temperature rise of about 8 deg. C. to 10 deg. C. fully exposed to radiation. It seems to us that a service should be capable of carrying overload capacity in excess of that of the motor without any injury whatever."

A point that should not be overlooked in this connection is the fact that all present installations are demonstrating the safety of using smaller copper in induction motor services. Between the motor and the compensator is a section of wire which is usually very much smaller than that which would be used if the installation were figured at 125 per cent full load current. If a smaller wire will suffice here, the question is often asked why it will not also be satisfactory for the entire service.

WIRING AND FUSING ARE SEPARATE PROBLEMS

To assist in carrying out his thought that wiring and fusing should be considered separately Mr. Tousley of Chicago makes the following additional points and presents a particularly convincing table. Mr. Tousley wrote: "The questions of the fusing of a motor and the size of wire should be entirely separate and distinct.

"The fusing of a motor is determined by the normal current taken by this motor and should in all cases be determined by the amount of current normally taken by the motor and not by the amount of current taken at starting. A motor may be protected in any of the following ways: (a) By the starting fuse if such fuse is not of a capacity much greater than the normal running current of the motor; (b) by running fuses; (c) by time-limit relays; it being understood that overload releases may take the place of running fuses.

"The size of wire to be used should depend on the normal running current plus an overload of reasonable amount. This has been determined as 25 per cent over the normal current of the motor. The carrying capacity of a wire is restricted by the amount of heat generated in that wire. It is a fact, easily proven, that the short intervals of time during which a wire is overloaded by the starting current are such as to have no appreciable effect on the heating of the wire.

"It is also a fact that the size of fuse protecting a wire has, so far as short circuit is concerned, no effect on the wire from a safety standpoint. In other words, it makes no difference whether a No. 14 wire is protected by a 15 amp. fuse or by a 30 amp. fuse. It is just as safe in the latter case as in the former. The Code permits overfusing so that I do not see how there can be any objection to overfusing in the case of alternating current motors.

"The use of large wire is objectionable. First, because it apparently sanctions an overfusing of the motor; second, because it is a useless expenditure of money. Inspectors cannot overlook this feature. Witness the agitation for concentric wire.

"The use of the horsepower rating of motors in making inspection rules and tables has resulted in a great deal of confusion owing to the fact that the current under normal full load conditions is not the same for all horsepowers or for all types of motors. Experience has proven, however, that for practical use a table based on horsepower ratings is very desirable from an inspection standpoint. Our department has used such tables for years.

"If we are convinced of the fact that a wire of 25 per cent over the normal running current of alternating current motors is satisfactory, then we may devise a wiring table by classifying alternating-current motors into groups having similar efficiencies and power factors, again subdividing these into groups of motors under these various classifications.

"Published herewith is a table which will illustrate this point. The first column indicates the horsepower of a series of motors. The second shows the current on a basis of 90 per cent efficiency and 85 per cent power factor, this giving a combined efficiency and power factor of 76 per cent. This is the basis of the present Chicago rules.

"The third column gives the size of wire required by the Chicago Rules and the third column the size of fuse allowed. Under the heading General Electric Rating is given the rating of full load current of General Electric Company motors. In the next two columns is given the combined efficiency and power factor of each size of motor and of each group of motors.

"The next four columns give figures calculated on the basis of the Code ruling and using the General Electric figures for current. The column headed 'overhead rubber covered wires %' shows the carrying capacity of the wire required by the code rule in per cent of the General Electric ratings. This percentage runs from 204 per cent in the smaller size motor to 131 per cent in the larger size motors.

"The next two columns show the current and size of wire to be used on a basis of 125 per cent over the normal full-load current of motors of the various groups. The normal full-load current is calculated on a basis of the General Electric ratings for efficiency and power factor as shown for the average of the three groups.

"The column showing the values at 125 per cent overload for the average efficiencies as shown by the General Electric tables is not greatly different from the figures shown by the Chicago rules. This is due to the fact that while the combined efficiency and power factor assumed by Chicago is higher (76 per cent) we require a wire of 150 per cent of the normal capacity."

SUGGESTED SIZE OF FUSES AND WIRE TO USE WITH DIFFERENT MOTORS

Motor Data							National Electrical Code Rules, Rubber Covered Wire					125 Per Cent Average Efficiency and Power Factor				
							—250%—		—200%—							
Size in Hp.	Amp. at 90% Efficiency and 85% Power Factor Equals 76% Combined Efficiency	Size of Wire Required by Chicago Rules	Size of Fuse Required by Chicago Rules (Amp.)	General Electric Rating in Amp., on 60 Cycle, 220 Volt, Slow Speed Induction Motors	General Electric Combined Efficiency and Power Factor in Per Cent	Average Combined Efficiency and Power Factor for Group	Amp.	Size Wire, Table B	Amp.	Size Wire, Table B	Overload Per Cent, Rubber-Covered Wire	Amp.	Size Wire (Rubber Covered)	Size Fuse, Table B	N. E. L. A. Requirements' in Amp.	Size Wire, B *
1	3	14	23	4.8	41	..	12	14	...	...	...	4.8	14	20	13	14
2	5	14	23	9.8	40	..	24	12	...	...	204	9.8	14	20	26	12
3	8	14	23	109	54	50	27	10	...	...	230	146	14	20	39	8 250
5	13	12	30	16	61	..	40	8	...	...	220	244	10	30	65	6
7.5	19	8	53	24	60	..	60	6	...	...	210	36	8	50	97	3
10	26	6	75	34	57	..	..	..	68	6	147	37	6	70	90	4
15	38	4	105	44	67	..	..	..	88	4	159	56	5	80	135	1
20	51	3	120	59	66	65	..	..	118	2	152	75	3	100	180	0 195
25	64	1	150	76	65	..	..	..	152	1	131	94	1	150	225	2/0
30	77	0	188	...	..	..	..	..	...	...	...	112	0	200	270	3/0
36	90	00	225	105	65	..	..	..	210	00	142	121	0	200	210	2/0
50	128	4/0	263	150	65	..	..	..	300	200	133	172	3/0	275	300	200
75	192	350	450	205	73	..	..	..	410	300	138	258	300	400	450	400
100	256	500	600	282	70	71	..	..	564	500	191	345	500	600	600	500 180
150	384	900	900	418	70	..	..	..	836	800	131	517	800	840	900	900
200	512	1300	1155	556	71	..	..	..	1112	1200	131	693	1100	1080	1200	1300
250	640	1800	1455	...	..	..	..	..	...	...	...	...	...	...	1500	1700
300	768	2-900	1800	...	..	..	..	..	...	...	...	...	...	...	1800	....

* 125 per cent of the normal current on a basis of the combined efficiency and power factor shown by

G. E. Tables $\frac{746}{220\times1.73} = 1.96 \times \frac{125}{50} = 250$ per cent, etc.

Thermal Conductivity of Underground Ducts

A Preliminary Study, Though Not Quantitatively Conclusive, Suggests the Importance of Investigating Thermal Properties of Conduits Upon Which the Load Capacity of Underground Cables Depends—Testing Methods Are Described

BY WILLARD S. WILDER
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THE capacity of underground cables is limited by the maximum temperature which the cable may reach without damage to the insulation. In the case of rubber this limit is fixed at 60 deg. C. (140 deg. F.) by the A. I. E. E. rules. When the cable is laid in underground ducts the heat developed can be passed off at a rate depending to a considerable extent upon the thermal conductivity of the duct system. In general, cables laid underground will have to be larger, for the same load, than cables used in open air, since their confinement in the ducts eliminates any possible cooling by convection currents of air. In Europe the practice is quite general to lay cables directly in the earth, permitting a greater current density due to the readiness with which the heat developed is passed off through the earth.

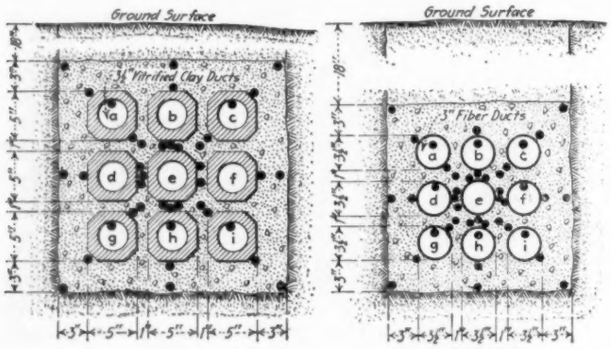


FIG. 1—CROSS-SECTIONS OF TILE AND FIBER DUCT SYSTEMS UNDER TEST

Any heat liberated in such a cable must pass from the conductor through the insulation to the lead sheath, from which it must be dissipated by radiation or conduction. The possibility of dissipation by convection is very small since the cables are surrounded by dead air. Placing the cable in a good conducting medium will materially increase the carrying capacity by removing the heat from the cable so fast that the temperature will not rise to an excessive value. Numerous experiments have been carried out to remove the heat developed, examples being those of flooding the ducts with water, blowing air through them or filling the ducts with vaseline or oil. While these plans will remove the heat from the cables more rapidly than is possible with the dead air, there is little to be gained unless the material of the conduit run is a good conductor of heat, permitting it to escape to the surrounding earth without much increase in temperature.

The purpose of the investigation undertaken by the writer was to determine whether there exists a great enough difference between the heat conductivity of tile and fiber duct to make a saving in cable investments possible by the use of the better duct. Since the construction and maintenance costs are nearly the same for conduit runs built of the two duct materials, any saving due to better heat conductivity of one material would be a clear gain and worth considering when the amount of copper saved is considered.

In order to investigate the saving effected by the use of a duct material having good thermal conductivity, consider two conduit runs, one laid with duct material A and the other with material B, the construction for the two runs being identical except that duct material A has a 10 per cent greater heat conductivity than material B. The heat produced by an electric current is given by

$$H = k\,I^2R\,. \qquad (1)$$

Since conduit run A is a 10 per cent better conductor of heat than B,

$$H_b = H_a 0.9. \qquad (2)$$

$$k_b I_b^2 R_b = 0.9 k_a I_a^2 R_a. \qquad (3)$$

If the cables are to have the same carrying capacity,

$$I_a^2 = 1_b^2; \qquad (4)$$

therefore

$$R_b = k0.9R_a. \qquad (5)$$

The size of cable necessary is determined by its resistance from the following formula:

$$R = cL/A. \qquad (6)$$

For copper cables of equal length C and L will be equal and

$$I/A_b = k0.9/A_a \qquad (7)$$

$$A_b = k1.11A_a. \qquad (8)$$

This shows that for the same load the cable laid in duct material B, which has a 10 per cent lower thermal conductivity than material A, will have to be 1.11 times as large. With copper selling at a high price, such a saving will amount to a great deal on the initial investment of an installation.

PREPARATION OF DUCT SYSTEMS FOR TEST

In order to determine the temperature rise in typical conduit lines tile and fiber ducts were laid end to end and the conductors carrying the heating current were pulled through the two systems in series. These conduit runs were made with nine ducts arranged as shown in plates 1 and 2. The length of each run was made 9 ft. (2.7 m.), giving a distance of 4.5 ft. (1.4 m.) each side of the middle section where the temperature was measured, this being considered enough to eliminate any error due to the cooling of the ends. The entire length of the run was 23.5 ft. (7.2 m.), giving 1.5 ft. (0.46 m.) between sections and 2 ft. (0.61 m.) at each end for access to the ducts for the purpose of drawing wires through them. The conduit runs were over 15 ft. (4.6 m.) from any building walls so that errors due to heat from that source were removed. The ducts were laid in a concrete mixture of 1:3:5 and were placed 1 in. (2.5 cm.) apart, the joint being staggered. The trench in which the ducts were laid was about 4

ft. (1.2 m.) deep, the concrete and the ducts being at the bottom and covered by 1.5 ft. (0.46 m.) of earth. After inserting the heater ribbons through the ducts, the ends of each duct run were plugged with asbestos wool to prevent heat loss from the interior. Boards were then laid over the openings at the middle and ends of the duct section, and the whole run was covered under a large snow drift, which served to keep the heat in the ducts and to prevent the circulation of cooling air.

The fiber duct used in these tests was the standard 3-in (7.6-cm.) socket joint conduit with the interior diameter of 3 in. and a wall thickness of $\frac{3}{8}$ in. (9.4 mm.), making the external diameter $3\frac{3}{4}$ in. (9.5 cm.). The external radiating surface of the duct was 11.8 sq.in. (76 sq.cm.) per inch length or 141 sq.in. (910 sq.cm.) per duct foot. The tile duct had a bore of $3\frac{3}{8}$ in. (8.5 cm.), the outside surfaces being in the form of a square with the corners cut off and having a wall thickness of $\frac{5}{8}$ in. (15.9 mm.). The radiating surface was thus 17 sq.in. (110 sq.cm.) per inch length, or 204 sq.in. (1320 sq.cm.) per duct foot.

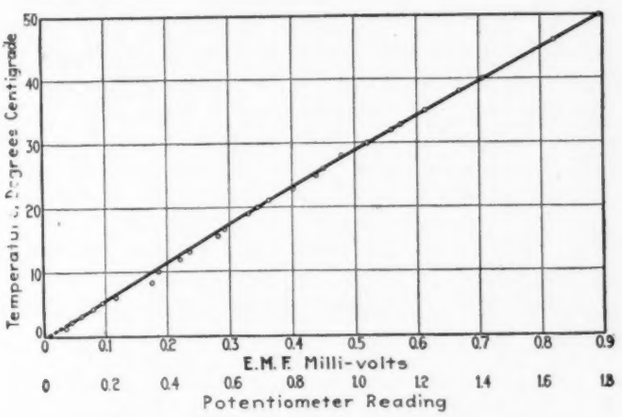


FIG. 2—CALIBRATION CURVE FOR THERMOCOUPLES

Thermocouples were chosen as the best means for measuring the temperatures through the cross-sections of the ducts. They were distributed throughout the cross-section of each conduit run as shown in Fig. 1. The thermocouples were made of No. 20 copper wires soldered with a drop of solder to No. 20 "Advance" wires of the Driver-Harris Company. Care was taken in making the couples to twist the wires together at the tips and secure a solid joint by dipping the tips in molten solder. A couple made in this manner and with these materials was found to be very sensitive to slight changes in temperature and to produce an electromotive force of about 0.017 millivolts per degree change in temperature. In order to use the thermocouples to indicate temperatures it was necessary to calibrate them with the base joint at a constant temperature and the couple at a known temperature, always keeping the base joint, when using the couple, at the same temperature for which it was calibrated. Two wires from each couple were run through the ground, the copper wire being extended through a cable to a switch in the building, the "Advance" wires soldered to brass boxes to form the base joints, these boxes being at the surface of the ground above the duct sections.

A test couple was then made up in the same manner as the other couples, one end being dipped in ice water and the other in a beaker of oil. The temperature of the oil was varied by the heating coil, and the emfs. of the couple and the corresponding readings of the standard thermometer which was immersed in the oil were noted. The calibration curve as shown in Fig. 2 was thus obtained and was found to check the points ob-

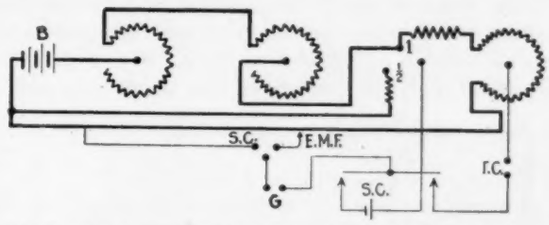


FIG. 3—SIMPLIFIED DIAGRAM OF POTENTIOMETER CIRCUIT

tained previously in the calibration of the couples for the runs. Convenient testing arrangements enable the operator to take readings on any of the thermocouples at will.

A potentiometer and galvanometer were employed to measure the emfs. of the couples, since this method took no current from the couples, with resulting errors due to potential drop in the leads. The potentiometer was one constructed especially for thermocouple work, the connections being shown in Fig. 3. The galvanometer was of the moving-coil type manufactured by the Tinsley Company. A Weston standard cell was used for the standard emf. and a storage battery for the source of current to produce the potential drop.

The conduit runs were heated by two ½-in. (12.7-mm.) ribbons placed in parallel through the middle duct of each section. This heating ribbon was of "Nichrome" and had a resistance of 103 ohms per 1000 ft. (340 ohms per km.). The energy for heating ribbon was obtained from the city supply stepped down from 110 to 55 volts.

For further tests one and one-half sections of tile and fiber duct were placed in sand and tested as a check

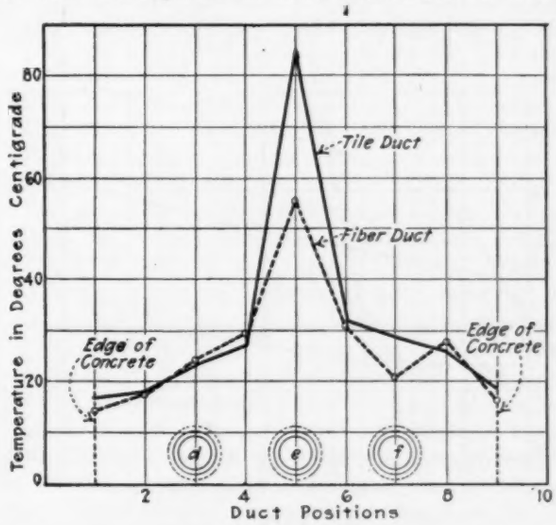


FIG. 4—TEMPERATURE GRADIENT THROUGH CENTER OF DUCTS *d*, *e* AND *f*

upon the results obtained from the conduit runs laid in earth. In this case the interiors of the sections were heated by Nichrome ribbons as in the conduit runs, but the temperatures inside and out were measured with mercury thermometers. To produce uniform conditions about the ducts they were placed on end in a pail and surrounded by a sheet-metal cylinder of 10 in. (25

cm.) diameter, the space between the cylinders and the ducts being filled with sand. The interiors of the ducts were left empty and the ends plugged with asbestos paper.

POSSIBLE INTERPRETATION OF RESULTS

Data were obtained from which it was possible to plot curves showing the temperature variation through duct sections in different directions. Fig. 4 shows such curves through the centers of the ducts *d*, *e* and *f* in each case. These data are the average of seven temperature readings taken over a period of eleven days after the temperature conditions throughout the conduit runs had become constant.

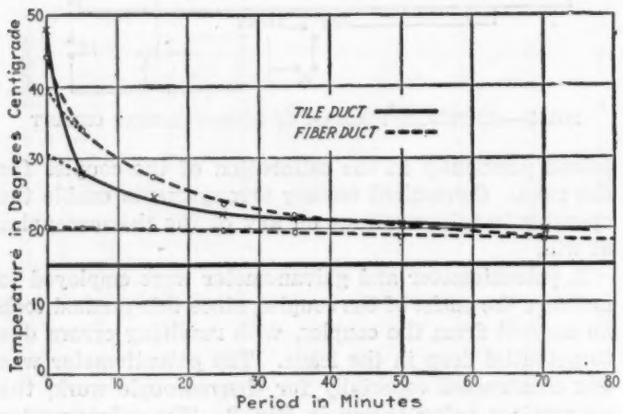
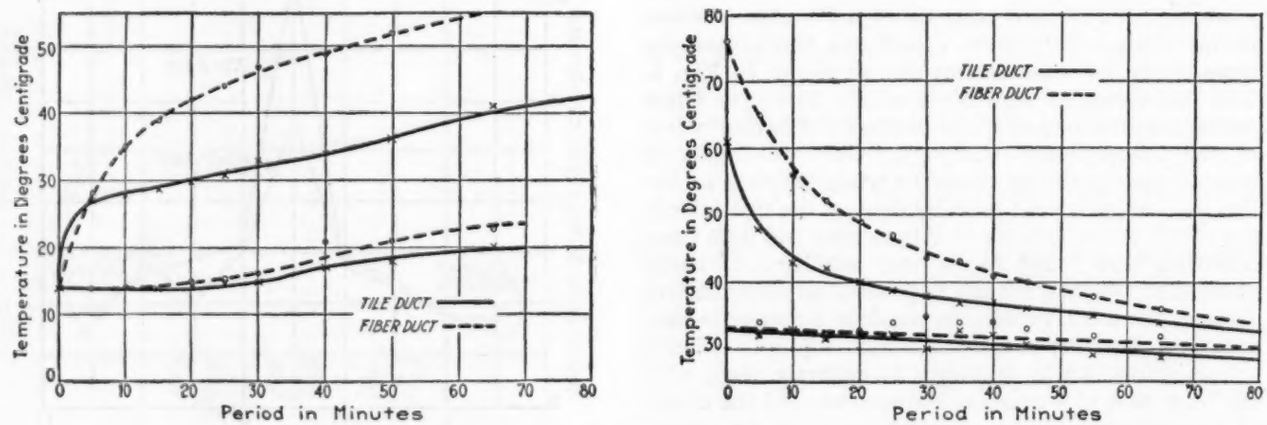


FIG. 5—COOLING CURVES FOR DUCT LINES IN CONCRETE
Short dotted lines indicate possible maximum temperature in center duct *e*

While the curves indicate a much higher temperature at the interior of the tile duct than for the fiber duct, later curves show that the interior of the fiber duct was the warmer, the wrong indication to these plates being due to closer proximity of the thermocouple to the heater ribbons in the tile duct than in the fiber duct. The temperature gradients from the interior to the exterior of the conduit runs are seen to be slightly steeper for the fiber-duct conduits run than for the tile. This would indicate a more uniform temperature through the tile-duct section than the fiber-duct section, or a better conductivity for the tile conduit run. Since the greater part of the duct sections were concrete, the conduit forming only a small percentage of the whole section, any results obtained from these curves are very similar for both sections.

Fig. 5 shows the temperature drop with time, after turning off the heat in the ducts. The upper curves, which show the temperature drop in the middle duct where the heater ribbon was placed, indicate how the position of the couples relative to the heater ribbons caused an error in the indications of the temperatures of the middle ducts, as shown in Fig. 4. Five minutes after the current was turned off, which was ample time for the ribbon to cool down to the temperature of the ducts, the interior of the tile duct was much cooler than the interior of the fiber duct, the extended dotted lines representing the possible initial temperatures. The temperatures fell in both ducts, but more rapidly in the fiber duct, and after forty-five minutes the temperature in the fiber duct was less than that in the tile duct. Since, for the same length of duct, the volume of material in the tile duct is much greater than in the fiber duct, the heat stored in the tile duct is not conducted away as rapidly as that stored in the fiber duct, with the result that the fiber duct should cool off sooner than the tile duct, as the curves indicate. The lower set of curves show the temperature drop with time in the concrete immediately surrounding the ducts. Since the radiating surface of the tile duct is much greater than the fiber duct, the temperature at a given point in the concrete near the tile duct should be lower than at a similar point in the fiber duct. The lower set of curves show the temperature in the concrete about the fiber duct to be greater than in the concrete about the tile duct, the temperature about the fiber duct decreasing as the duct cools off, while the temperature about the tile duct is nearly constant because of the heat stored in it.

Fig. 6 shows the temperature rise in the 1.5-ft. (3.75-cm.) duct sections after turning on the heat in the ribbon through the center of the sections. In this case the ducts were surrounded by sand, but the interiors contained dead air, the heater ribbons being held in place with asbestos plugs in the ends of the ducts. The upper curves, which show the temperature rise on the interior of the ducts, indicate a greater temperature in the interior of the fiber duct than in the tile duct, showing that the tile duct conducts the heat away more rapidly than the fiber duct, thereby keeping the interior cooler. In the tests on the short duct sections the heater rib-



FIGS. 6 AND 7—HEATING AND COOLING CURVES FOR SHORT DUCT LENGTHS IN SAND

bons for each duct were in series which eliminated any errors due to more heat being formed in one duct than in the other. The lower curves show the heat rise in the sand about the duct sections and show how the greater radiating surface of the tile duct makes the temperature at a point near its surface cooler than a similar point near the fiber duct.

The drop in temperatures inside and outside of the ducts after turning off the current in the heater ribbons are shown in Fig. 7. The upper curves show the temperature drop with time in the interiors of the ducts and indicate that in each case the tile duct conducts the heat away more rapidly, making the interiors of the tile ducts cooler than the interiors of the fiber ducts. In each case the heat stored in the material of the ducts keeps the tile duct warmer for a longer period than the fiber duct, because of the greater amount of material in the tile duct. The lower curves in this plate show how the temperature in the sand about the ducts decreases with time.

While a quantitative analysis of the heat conductivity of the two materials would be very desirable and would give exact data relative to the saving effected by the use of one kind of duct, it would be very difficult to make such an analysis with the degree of accuracy required for such computations. Since the material of the duct forms but a very small part of the total material separating the cable and the surrounding earth, means for measuring the temperatures in the ducts very accurately would have to be employed and very accurate data relative to the amount of heat generated in the ducts and passing through the conduit would have to be obtained. Experiments similar to this investigation carried out on a commercial basis should be of great importance and give information of an interesting and valuable nature. Two similar conduit runs, one of tile duct and one of fiber duct, laid under like conditions and of commercial lengths, should be employed. The cables in the ducts could be those supplying power to a load and the power loss in a given length of duct noted by wattmeters. The average temperatures through the lengths of ducts should be noted and a comparison made between the temperature rise and heat losses in the tile and fiber conduit runs.

APPLYING MOTORS TO OIL-WELL PUMPING

Two-Speed Variable-speed Motor with Control Apparatus Connected Is Mounted on Skids and Hauled Out to Well Ready to Operate

BY W. G. TAYLOR

Power and Mining Engineering Department,
General Electric Company

THE two-speed slip-ring induction motor with both speeds variable has proved to be especially adaptable to pumping, pulling, bailing, cleaning out, swabbing and other work connected with oil-well pumping. Besides improving on engine drive in many respects, such as by increasing production due to more uniform pumping motion and fewer shut-downs, reducing rod breakage, lowering operating costs and affording greater convenience in operation, it possesses all the flexibility of engine drive.

Pumping the well requires continuous operation of the motor usually for weeks at a time without change or shut-down, with a low power demand and at a comparatively low speed of the rig. Under these conditions high efficiency is desirable, and speed control is necessary to adjust the number of strokes per minute to changing conditions at each well. Pulling rods and tubing, which is necessary at intervals to clean out the well or replace broken or worn parts, as well as all of the other roustabout work, is done at high speed to save time and get the well back on a producing basis without

OIL-WELL OPERATED BY 30/15-HP. TWO-SPEED VARIABLE-SPEED MOTOR. NOTE COUNTERWEIGHT ON WALKING BEAM

unnecessary delay. All of this duty demands the characteristics of a high-torque hoist motor. The two-speed variable-speed oil-well motor has these two widely different characteristics combined in one machine.

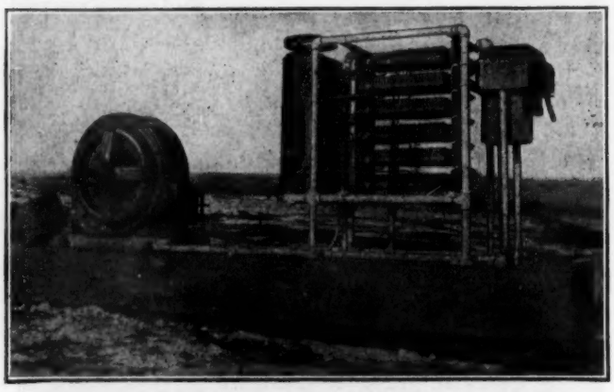
Although a number of wells of moderate depth have been equipped with motors rated at 25/8 hp. or 25/10 hp., the machine which meets the greatest variety of conditions is rated at 30/15 hp. The higher rating is developed at a synchronous speed of 1200 r.p.m. for pulling, bailing and similar work and the lower rating at 600 r.p.m. for pumping duty. By means of a pole-changing switch mounted on the frame of the motor the speed is readily changed as desired for the work to be done, one position connecting the stator windings for six-pole operation and the opposite throw for twelve poles.

In the particular motor which the writer has in mind the rotor is wound six-phase, requiring six collector rings, and is built to run safely at double speed, or 2400 r.p.m., which is a measure of prevention against damage in case an operator carelessly allows the speed to become excessive when lowering tubing into the well. Speed variation on either the six-pole or twelve-pole connection is obtained by a drum controller and secondary resistance, giving a speed reduction of 50 per cent at full-load torque at either high speed or low speed, with ten points of control, all being running points. The resistors are specially designed for the heavy duty. The controller is installed near the motor and operated by a rope wheel from the "headache post" at the derrick.

An automatic device in the base of the controller, actuated by a coil in series with the primary circuit of the motor, prevents the controller from being moved past the fourth point until after the current has dropped below a predetermined value. An unskilled operator is thus prevented from abusing the equipment and is at the same time automatically taught to handle

the controller in the proper manner to obtain the best results.

The motor is fully protected by a triple-pole oil circuit breaker equipped with automatic under-voltage release and two-coil series inverse- time-limit overload trip. The overload trip coils are double-wound in order to provide protection on both pumping and pulling duty. These coils are electrically interconnected with the pole-changing switch on the motor frame in such a manner that whenever the latter is thrown to either



TWO-SPEED MOTOR, CONTROLLER AND RESISTANCE GRIDS MOUNTED ON SKIDS

the high-speed or the low-speed position the coils are connected to trip the switch at an overload corresponding to the motor rating in use. This method of interlocking makes it impossible for the motor to be left without adequate protection, particularly when running unattended on low speed for pumping.

Many of the installations in Kansas are equipped with an ammeter, mounted on the cover of the oil circuit breaker. This makes it easy, to counterbalance the well to give minimum fluctuations of input to the motor and also serves as in indication of the condition of the well when pumping. The ammeter is not in circuit when the motor is connected for high speed. A watt-hour meter is also installed at each well on most leases. This enables the operation of the well to be more closely watched from month to month.

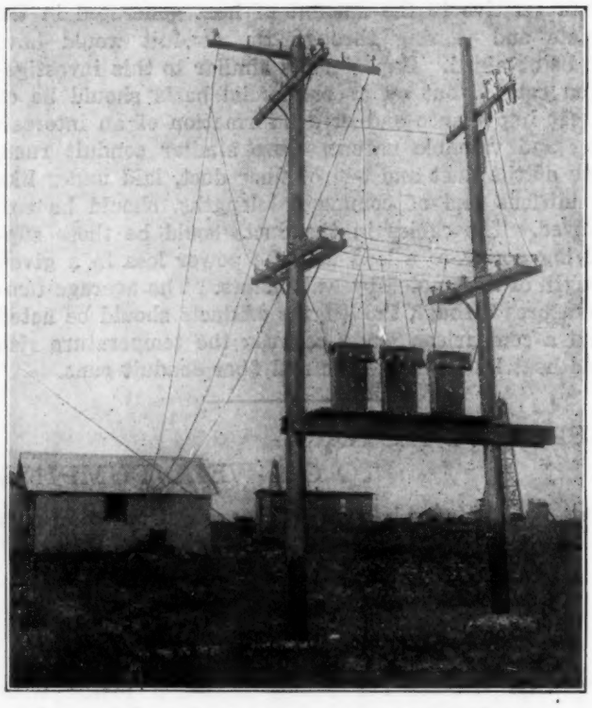
The walking beam on the standard rig is actuated by a crank on the shaft of the band wheel, and the latter is belted directly to the engine when steam or gas is the motive power. With motor drive it is necessary, on account of the higher speed, to interpose a countershaft, which is usually installed where an engine would be placed. The motor is belted to the countershaft and is usually placed between the latter and the band wheel, so that both belts will pull in the same direction on the countershaft. This method cannot always be followed, however, when an engine is being replaced by a motor, as it is then necessary to make the complete electrical installation before the engine is shut down, so as to avoid loss in production by any unnecesary delay in changing over to electric operation. Generally the countershaft can be placed in front of or behind the engine pulley and the motor lined up to it from either the front or the rear, depending upon the space available and the amount of alteration necessary to the building. In California it is becoming the practice to install an engine temporarily on the derrick floor, or a back-geared motor near the band wheel, using a short belt, thus permitting the old engine to be entirely removed before the electrical equipment is put in place.

The control equipment is all mounted on a pipe or angle-iron framework, with the resistors inside the frame and the controller and an oil switch on the outside. This makes a neat and compact arrangement which is very readily accessible.

On the majority of wells the motor and the framework carrying the control equipment are mounted on skids consisting of two heavy timbers bolted together. The complete outfit is thus wired up at the shop and brought as a unit to the well, where it is a small matter to connect the incoming lines after the motor is lined up. This greatly facilitates the work of installation. Small concrete blocks are put in as supports for the skids, and a large block supports the countershaft.

The wiring is put in steel conduit throughout. The incoming lines first pass through a fused triple-pole lever switch which is used as a disconnecting switch and which is placed in a galvanized-steel cabinet that can be locked to prevent tampering. This cabinet is generally mounted on the wall, but it can be readily placed on the pipe framework with the other control apparatus.

It was mentioned in a foregoing paragraph that the wells are counterbalanced. This is accomplished by suspending a heavy weight, consisting of a box of scrap iron, broken concrete or rock, from an extension of the walking beam, this box being carried on the outer end of a heavy timber which has a fulcrum on a post in the ground. In Oklahoma an improved counterweight is



TRANSFORMER BANK SERVING OIL-WELL HOUSE

now being introduced, this consisting of a concrete block supported from an extension of the crank end of the walking beam by an iron pipe hooked to an eye bolt imbedded in the concrete. The upper end is hooked to a stirrup hanging from the walking-beam extension.

Counterweights not only reduce the fluctuation of current input to the motor but actually reduce the kilowatt-hour consumption as much as 20 or 22 per cent.

Developing Electrically in England

"Electrical Development Association (Great Britain and Ireland)" Makes an Appeal on Social as Well as Economic Grounds for Installation of Electricity and Large Utilization of Appliances in Housing Projects

From James M. Wakeman, General Manager Society for Electrical Development

REPLYING to the request made by the ELECTRICAL WORLD for comment upon the formation of the Electrical Development Association of Great Britain and Ireland: Some of the men whose names appear upon the executive committee of that association have for some time past been in communication with the Society for Electrical Development, Inc., of New York. Several months ago one of them asked for our booklets upon the "Aims and Achievements of the Society," "The Story of Electrical Prosperity Week," "How a Three-Billion-Dollar Industry Pulled Together in America's Electrical Week," and other pamphlets setting forth our activities.

More recently J. W. Beauchamp, their secretary, wrote: "You may be sure that my governing committee have been greatly stimulated by the work which your association has carried out in America, and it has been realized for a very long while that similar work should be undertaken in this country."

This correspondence shows that the British have been for some time past considering the advisability of carrying on in Great Britain the same kind of development work we have been employing for the past five years, and it is evident that as soon as the war ended they got busy.

I should like to point out the fact that the recognition by the electrical men of Great Britain of the advisability of such work in their country emphasizes the necessity of its continuance in the United States. Now more than ever before such coöperative work as that done by the society offers great assurance of profitable returns to live, wide-awake, progressive concerns that support and use the society.

Now more than ever before such work is needed to facilitate the extension of business and to develop a spirit of harmony and coöperation within the trade and toward the public. We are all interested in the cultivation of new fields of endeavor, the promotion of better business methods and the formation of correct public opinion.

I sincerely hope that both these organizations will receive the hearty support their constructive and progressive purpose merits.

IT IS usual for workers in the American electrical industry to be confident that new worlds to conquer for electrical application lie just ahead. There are additional or untried forms of application; there are large fields which are scarcely touched, as in railroad electrification. But while the new markets invite exploration there are still the old lines of activity, in which patient, untiring work yields sure results. It pays to remember that the saturation point has not been achieved in the districts reached by service lines or accessible by short extensions to such lines. Canvass among householders may not bring great returns for every ounce of effort, but it is still a road of expansion. It will add to the total number of customers and steadily to a more general use of appliances by those served. It means, furthermore, a strengthening of the position of the central-station company as the ideal economic producer of power for the entire community.

England's present position in electrical development is very different from that of this country, but its concern over unutilized opportunities is one of the most interesting events in a world-wide view of the industry. From whatever point the action of the British is regarded, it is one that promises better and more rapid electrical progress. It foreshadows increased use of electrical energy for lighting and power, broader markets for appliances, demand for apparatus and supplies to promote generation in larger units and distribution to the wider areas where electricity will be introduced. What is done in the British Isles will also be an educational stimulus to continental Europe and to the British colonies all over the world.

The work of the English Electrical Development Association follows in some respects the path of the earlier Society for Electrical Development of this country. It is especially illuminating to find the arguments advanced in the British Isles for the installation of electricity in housing prospects. What would be regarded in this country as elemental is considered of first importance in the "right tight little isles." Looking at the earnest determination with which the new English association attacks the question of electrification of homes, it is natural to recall earlier stages of the industry in this country. And this recollection leads to the suggestion advanced above, that there are still fertile fields for cultivation in this country, the value of which need not be miscalculated in order to be judged worthy of attention.

A review of publications of the Electrical Development Association (Great Britain and Ireland), of which J. W. Beauchamp, London, is director and secretary, shows that the social advantage of electricity in making happier homes is thoroughly realized by our English cousins. In a pamphlet on "Housing Construction and Electricity Supply" it is stated: "The demand for war workers in certain localities altered the distribution of the people, led to overcrowding and revealed the shortcomings and inconveniences of the average working-class house." And here is a reflection which leads to the recommendation that on any important building scheme the supply of electricity, as of water, should be made available before work is commenced:

"Impatience in regard to the progress of slum demolition and new construction is a contributory cause of unrest, and attention to this work, and particularly to the internal design and equipment of the new houses, is more likely to produce results quickly and assist in restoring contentment and productivity than many of the other schemes of social reform to which so much time is being devoted."

"Artificial light and mechanical power" are suggested

in a way which reads strangely to one used to the wholesale adaptation of electricity where labor can be saved or time economized in this country.

Says the English association:

Where electricity can be obtained for artificial lighting no other system is likely to be adopted, and its influence upon design should be taken advantage of. With this illuminant some reduction may be made in the height of rooms, and consequently in the cost of construction; lamps may be fixed close to the ceilings and advantage taken of their reflecting character to reduce expenditure upon shades and fittings; lighting and extinguishing from any convenient point or several points can be effected, and the provision of small power lamps over fireplaces, sinks and in other positions where household work is carried on makes for convenience, helps to reduce accidents and breakages and simplifies the task of the architect by providing him with a means of lighting which entails no special provision for ventilation, can be used in close proximity to ceilings and walls, is available in any power from a pilot light upward, can be operated from a distance, does not introduce the use of matches, flame or the risk of dirt inseparable from any other illuminant. . . .

The necessary ventilation can be provided more scientifically and more cheaply when buildings are being constructed, and if in some of these small rooms the fireplaces and chimney breast were omitted, the reduction in the cost of construction would be considerable, in some cases sufficient to pay for the whole of the electrical equipment. There appears to be a case for constructing houses of this class without fireplaces excepting in the main living and cooking rooms. These may be provided with stoves adapted to consume coal, coke and refuse and combined with the hot-water system of the house. If such appliances are properly installed and associated with electric cooking ranges, while some of the other rooms are permanently fitted with electric heating, the remainder being equipped with plugs so that portable electric fires can be used in them, the result is a dwelling with many labor-saving features, one in which the cost of maintenance and decoration will be low, the occupants' furnishings will be preserved and the housework reduced in every possible way.

In one letter the association outlines its representation of the three sections of the industry, "Supply, manufacturing and contracting." It shows the need of a coöperative movement in an argument similar to that which is advanced in this country for coördination of the industry.

"Urgent questions lie before the industry in regard to reducing the cost of installation and apparatus, simplifying mains and service work, and exploring the possibilities of new methods and amended regulations," the association says. "These essential objects will follow more rapidly from intensified demand for electricity supply than any other cause, and money spent on cultivating new and additional business cannot fail to react to the advantage of the industry and of the consumers, by stimulating the development of new methods and designs and assisting in standardization of apparatus and production in bulk, which is needed to meet the increase in cost of all classes of electrical work."

E.D.A.

THE ELECTRICAL DEVELOPMENT ASSOCIATION.
(Great Britain and Ireland.)

J. W. BEAUCHAMP,
Director and Secretary

Associations of Supply, Manufacturing, and Contracting Interests represented on Managing Committee.

The Institution of Electrical Engineers.

The Incorporated Municipal Electrical Association.
The Conference of Chief Officials of London Electric Supply Companies.
The Incorporated Association of Electric Power Companies.

The British Electrical and Allied Manufacturers' Association, Inc.
The Electrical Contractors' Association.
The Cable Makers' Association.
The Electric Lamp Manufacturers Association.

STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

SUBMERGED TURBINE BEARINGS LUBRICATED FROM MAIN FLOOR

The Installation of a Grease Gun System of Piping Prevents Premature Wear and Breakdown in the Gate Rigging

In order to reduce wear on the bearings of reach rods and operating rods of the double-runner water turbine, at the Holtwood plant of the Pennsylvania Water & Power Company, which are submerged and inaccessible, a grease gun with a system of piping was designed so that grease could be forced from the gun barrel (situated on the generator floor) through piping to the submerged bearings. This arrangement of piping solved the problem of keeping these bearings properly lubricated and preventing premature wear and breakdown in the gate rigging.

All previous efforts and devices to keep submerged bearings lubricated at this station had been unsuccessful. Corrosion had been rapid and the attendant increase in maintenance was considerable. All units with submerged bearings are now equipped with grease guns.

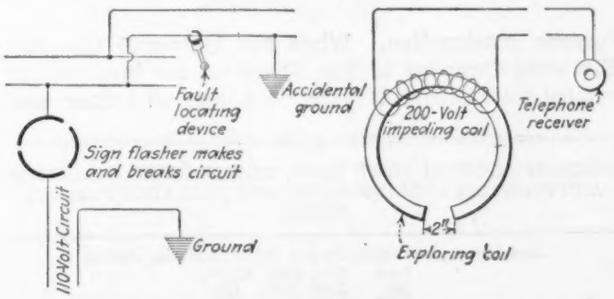
N. B. HIGGINS.

Baltimore, Md.

METHOD OF LOCATING GROUND ON A DISTRIBUTION SYSTEM

A Home Made Device that Can Be Conveniently Used by Line Men in Locating Ground on Overhead Lines

The accompanying illustration shows the method used by a Southern company by which an ordinary sign flasher can be used to produce an audible signal that will aid line men by means of an exploring coil



PRINCIPLE OF GROUND DETECTING DEVICE AND METHOD OF USING

to locate grounds on overhead lines. The flasher is connected to a 110-volt circuit with one side of the circuit grounded. The line man then goes over the system, starting from the power station, and explores the lines with a small exploring coil and telephone receiver. By means of this exploring coil, the make and break of the circuit by the flasher can be distinctly heard up to the point where the line is grounded. Beyond that point no sound is heard. In this way, the actual ground can be easily located.

The exploring coil used in this case was a home-made one, consisting of an old arc-lamp reactance with a section sawed out about 2 in. wide. On this coil a 200-volt impeding coil from an old Fort Wayne wattmeter was inserted, with the terminus connected to a watch case telephone receiver.

STANDARDIZED LAYOUT FOR OUTDOOR SUBSTATIONS

Used for Serving Industrial Plants when Various Sizes of Transformers Are Needed—Apparatus Arranged in Units

Replacement of any part of the standard outdoor transformer substations installed by the West Penn Power Company of Pittsburgh, Pa., is possible without interfering with the rest of the layout. Sometimes

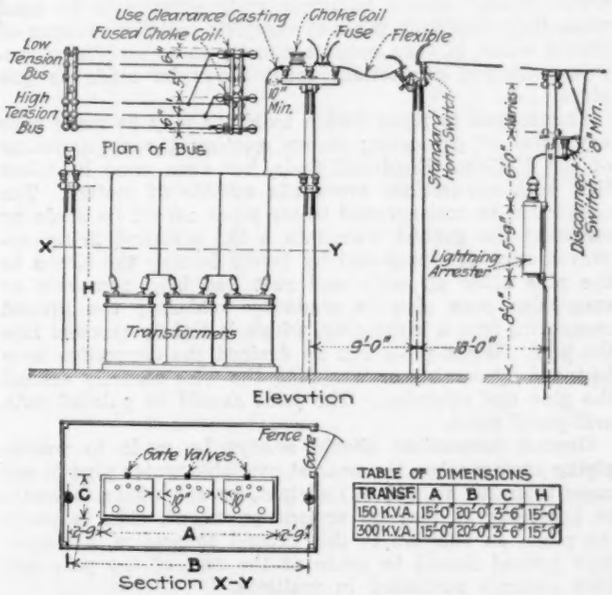


TABLE OF DIMENSIONS

TRANSF.	A	B	C	H
150 K.V.A.	15'-0"	20'-0"	3'-6"	15'-0"
300 K.V.A.	15'-0"	20'-0"	3'-6"	15'-0"

STANDARD 25,000 VOLT OUTDOOR TRANSFORMER SUBSTATION

during the life of a station, according to A. W. Cartwright, superintendent of construction, new conditions develop which require additions or a change of location not foreseen at the time of the original installation. With the arrangement shown changes can be made without an entire redesign of the station.

The standard layout involves three poles which support the apparatus. On one, which also serves as a support for the high and low-tension buses, are installed a choke coil and a fused horn gap. From these wires run to a standard horn switch on a second pole and from there circuits lead to a third pole which supports the lightning arrestor.

GROUNDING SPECIFICATIONS FOR DISTRIBUTING CIRCUITS

Methods of Making Grounds on Alternating-Current Distribution Circuits Not Exceeding 250 Volts to Ground

Specifications based on the requirements of the National Board of Fire Underwriters have been drafted by the Carolina Power & Light Company and the Yadkin River Power Company to cover grounding of alternating-current distribution circuits operating at not more than 250 volts to ground. Some of these specifications given by L. V. Sutton follow:

Ground connections of overhead circuits should be at line poles, and one such connection should be made at the pole next to the transformer pole. Where this is not practicable connections may be made to service loops, in which case a separate ground connection should be placed upon each service.

Ground connections for lightning arrestors which will be on transformer pole should be installed and maintained separate from those for secondary distributing circuits. Transformer tanks should not be grounded.

Ground wires should be of copper and not smaller than No. 6 B. & S. gage and should be larger than No. 6 when the grounded feeder is larger. Ground wires on poles should be protected by wood molding or other permanent insulating covering throughout their entire length.

The only thoroughly reliable ground connection is to metallic pipes of an extensive water-supply system.

Ground connections, when underground, must not be made to heating or refrigerating systems or pipes other than water pipes. Inside buildings such pipes may be used when they constitute parts of complete metallic systems of piping which in turn connect directly to water-piping systems. Ground connections must never be made to gas pipes.

Connections to pipes within buildings may be made with any form of grounding clamp meeting the requirements of the National Electrical Code, but care must be taken that such connections are made outside of meters. The connection to underground water pipes should be made by sweating the ground wire into a lug attached to an approved type of clamp and by firmly bolting the clamp to the pipe after all scale and rust had been removed; or connection may also be made by soldering the ground connection into a brass plug, which is tightly screwed into the pipe. When pipes can be drained the connection may be made by serving or wrapping the wire securely around the pipe and soldering. The joint should be painted with acid-proof paint.

Ground connections should always be made to water-piping system when the nearest available water pipe is not more than 100 ft. (30 m.) distant, except where it would be necessary to tear up cement pavement, etc., to reach the pipe. In addition to this ground connection, a single-pipe ground should be made at the foot of the pole and both grounds connected in multiple.

In making a pipe ground use a 1-in. (25-mm.) galvanized-iron pipe 8 ft. (2.5 m.) long, driving its full length into the ground. A 2-ft. (0.6-m.) length of tile should be placed around pipe flush with surface of the ground. This tile should be kept filled to within an inch or so of the top with salt crystals.

Two 8-ft. (2.5-m.) pipe grounds should be installed at all places where ground connection cannot be made to water-piping system or a ground to permanent water depth installed. When installing the two pipe grounds one pipe should be located near the molding on the pole and the other pipe on the opposite side of pole, at least 5 ft. (1.5 m.) distant from the first ground if practicable. Both grounds should be set in tile and treated with salt.

In connecting a ground wire to a driven pipe ground use a standard ground cap that will screw on the end of the pipe and which has a small cup on its side in which the wire can be soldered If such a cap is not available, push a cork stopper or small wad of waste about 3 in. (7.5 cm.) down the pipe, scrape bare the end of the ground wire, double it back and insert it in the end of the pipe, and then fill the end of the pipe with solder.

Where secondary lines exceed 500 ft. (150 m.) in length a ground should be made every 500 ft, except in cases where the secondary is on the same street with the street railway, when but one ground should be made, this being situated at the pole next to the transformer pole. The ground must be made on the neutral wherever a neutral is accessible, otherwise one side of the secondary circuit must be grounded.

PREVENTING FUEL LOSSES DUE TO FAULTY INSULATION

Chart Shows Heat Loss Through Insulated and Non-Insulated Walls—Sixty Per cent of Heat Loss Is Preventable

Losses due to radiaton from boiler settings often greatly reduce economy in steam power generation. It is rather difficult to estimate the exact heat losses due to faulty insulation, owing to the fact that changes therein are seldom made without remodeling the entire

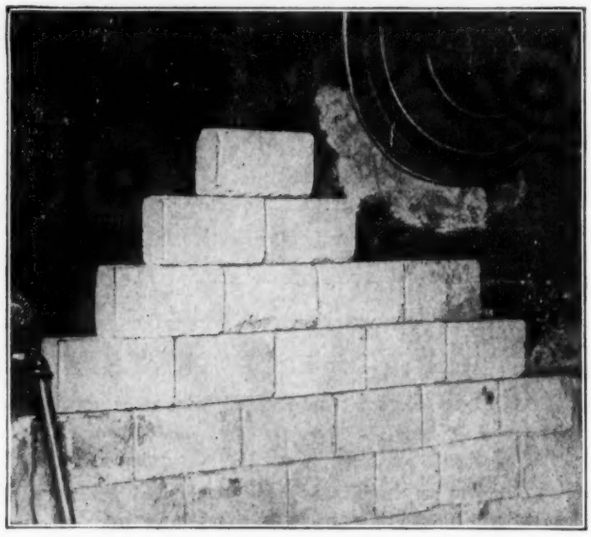


FIG. 1—SECTION OF BOILER SETTING BEING COVERED WITH INSULATING BRICK

furnace construction. When the Universal Gas and Electrical Company of San Francisco for instance, insulated their boilers, they replaced their oil burners and made other changes at about the same time. Accordingly it is impossible to determine exactly what proportion of the fuel saving effected was directly due to better

DIAGRAM SHOWING HEAT FLOW, TEMPERATURE GRADIENTS AND FUEL LOSS IN UNINSULATED AND INSULATED FURNACE WALLS

Fuel Losses per 1000 Sq.Ft. per Hr. of Radiating Surface

Wall	Fuel	Loss per 1000 Sq.ft. per Hr., B.t.u.	Lbs. Coal Loss per 1000 Sq.ft.	Gals. Oil Loss per 1000 Sq.ft.	Cu.Ft. Gas Loss per 1000 Sq.ft.	Calorific Value
Uninsulated	Coal	840,000	70	...	....	12,000 B.t.u. per lb.
Insulated	Coal	314,000	26	...	....	12,000 B.t.u. per lb.
Uninsulated	Oil	840,000	..	5.8	....	145,000 B.t.u. per gal.
Insulated	Oil	314,000	..	2.2	....	145,000 B.t.u. per gal.
Uninsulated	Gas	840,000	..	...	1400	600 B.t.u. per cu.ft.
Insulated	Gas	314,000	..	...	523	600 B.t.u. per cu.ft.

insulation. Proper insulation of boiler walls, however, will eliminate, it is estimated, at least sixty percent of the preventable heat losses through boiler walls. It is possible to calculate exactly what heat loss is incurred

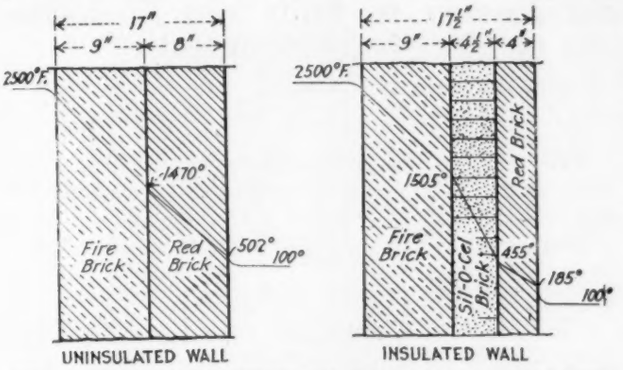


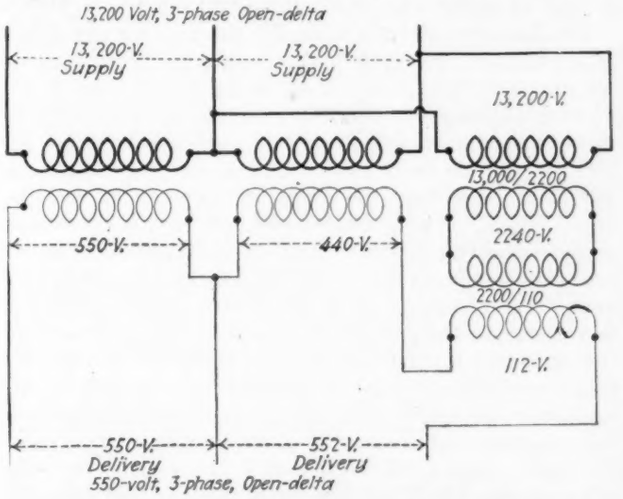
FIG. V—CHART FOR DETERMINING HEAT LOSS IN INSULATED AND NON-INSULATED WALLS

through insulated and non-insulated walls as shown in the accompanying chart and table. Where the loss of 840,000 B.t.u. (96,000 Cal. per kg.) is recorded through the non-insulated setting, this was reduced to 314,000 B.t.u. (36,000 Cal. per kg.) with adequate insulation. This represents a saving of 44,000 lb. (20,000 kg.) of coal, 3600 gal. (13,500 l.) of fuel oil or 877,000 cu.ft. (25,000 cu. m.) of gas per unit of radiating surface.

EMERGENCY CONNECTION FOR COTTON MILL TRANSFORMERS

How Three Odd Voltage Transformers Were Successfully Connected to Carry an Emergency 3-phase Load of 600 kw. at a Cotton Mill

On one occasion, when a southern central station company was called upon to furnish emergency service for a 600-kw. load to a cotton mill during the war, a problem was solved in an interesting manner with three



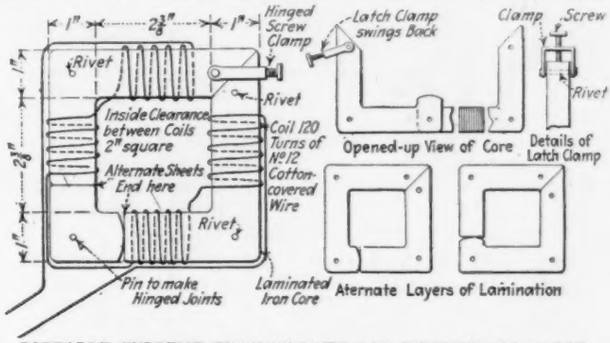
THREE ODD-VOLTAGE TRANSFORMERS CONNECTED TO GIVE APPROXIMATELY BALANCED THREE-PHASE CONDITIONS

transformers of different voltages. On account of the urgency of the connection and the impossibility of securing new transformers to carry the load within the time required, an inspection was made of the windings of three transformers which were of different voltage ratings, in order to determine the possibility of adapting the windings to an emergency connection. It was found that one of the transformers was provided with 110-volt taps on the secondary side, while the secondary voltages of the other two transformers were 440 and 550, as shown in the accompanying illustration. By connecting the 110-volt secondary of one transformer in series with the 440-volt secondary so as to boost the voltage, it was possible to secure a voltage on the secondary side of approximately 550 volts, which was satisfactory for the mill service. The diagram of connections as made in this emergency is shown in the accompanying illustration.

CURRENT TRANSFORMER FOR TESTING OF CABLES

Simple and Fairly Accurate Instrument Which Can Be Used Without Taking the Distribution Feeder Out of Service

So many advantages are obtained by testing apparatus or circuits without taking them out of service that any method for doing this that can be devised is usually worth while. The split-core transformer shown herewith enables this to be done. The important point in its construction being to obtain cleanly mor-



PORTABLE CURRENT TRANSFORMER FOR TESTING FOR CABLE FAULTS WITHOUT DE-ENERGIZING CIRCUIT

tised joints where the core opens, in order to secure a good magnetic circuit. Low reluctance is a requisite of the current transformer core. While the home-made transformer will not have the accuracy of the manufactured transformer, it will be inexpensive, it will be accurate enough for all the purposes of the troubleman, and it may be made in any size desired.

In the figure a convenient size of split-core transformer is shown. It consists of a hinged laminated iron core and one winding. The core has a cross-section of 1 sq.in. (6.5 sq.cm.) and is made up of varnished sheet iron. One corner of the core is hinged, the diagonal corner opening and being fastened by a screw clamp slotted into the core. The winding consists of one layer of No. 12 B. & S. gage cotton-covered copper wire. A layer of tape over the core separates the winding from the iron, and several layers of tape insulate the winding on the outside. The whole transformer is a little more than 6 in. (15 cm.) square.

The ammeter and its leads used with the transformer must be calibrated with it. If there are no laboratory facilities available to do this, the percentage of error of the device may be obtained by clamping the transformer on different conductors each carrying a known current. This factor may be used as a constant by which to multiply the readings of the ammeter.

Philadelphia, Pa. FRANK GILLOOLY.

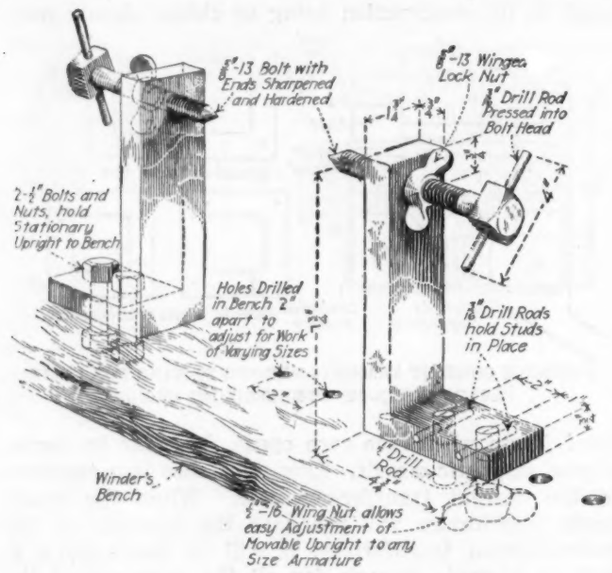
INDUSTRIAL APPLICATIONS

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

ADJUSTABLE ARMATURE STAND FOR LARGE REPAIR SHOP

Is Set on Each Winder's Bench to Be Used for Holding Armatures of Motors Rated at 5 Hp. Down to the Size Used in Fan Motors

For supporting small armatures that are to be wound and tested, a large repair shop in the east has provided adjustable bench stands for each of its workmen. The support consists of two $\frac{3}{4}$ in. by $1\frac{3}{4}$ in. (2 cm. by 4.5 cm.) pieces of cold rolled steel, one piece being fastened permanently to the bench and the other piece being movable. The accompanying illustration shows the positions of the fixed piece and the


⅜"-13 Bolt with Ends Sharpened and Hardened
⅜"-13 Winged Lock Nut
¾" Drill Rod Pressed into Bolt Head
2-½" Bolts and Nuts, hold Stationary Upright to Bench
Holes Drilled in Bench 2" apart to adjust for Work of Varying Sizes
¾" Drill Rods hold Studs in Place
Drill Rod
Winder's Bench
½"-16 Wing Nut allows easy Adjustment of Movable Upright to any Size Armature

ADJUSTABLE STAND FOR SMALL ARMATURES

movable one. The two are identical with the exception that the movable piece is provided with two $\frac{1}{2}$-in. (1.3 cm.) studs, one of which is threaded on the end, and which projects about $\frac{3}{4}$ in. (1 cm.) below. A wing nut permits the easy shifting of the stand.

The left-hand upright is fastened to the bench permanently. To the right of it is a series of $\frac{9}{16}$-in. (14 mm.) holes 2 in. (5 cm.) between centers for attaching the right-hand upright. Enough holes are drilled to accommodate armatures with shafts from 2 in. to 24 in. (5 cm. to 60 cm.) in length. Two hexagon head $\frac{5}{8}$-in. (16-mm.) machine screws with cone points support various lengths of shafts between the uprights. The ends of the bolts are ground to shape and hardened; a piece of $\frac{3}{16}$-in. (5-mm.) round cold-rolled steel about 4 in. (10 cm.) long is put through the head of the bolt to serve as a handle. The two $\frac{5}{8}$-in. (16 mm.) wings nuts are used as lock nuts to prevent the centre bolts from loosening.

This stand will accommodate armatures from motors rated at 5 hp. down to armatures such as used in fan motors.

New York, N. Y. C. A. JOHNSON.

PORTABLE-TESTING OUTFIT USED IN POWER SURVEY

By Its Use, the Motor-Rating of One Factory Has Been Decreased by 150 Hp.—Dummy Fuses Facilitate Connection of Meters in the Line

Because the Robbins & Myers Company manufactures motors it has been very easy for the operating departments to become over-motored, particularly during the war period when machines were running night and day at top speed and there was no time to question what size motor was best adapted to a particular drive. At that time it was considered good policy, in view of the fact that new machinery was being purchased wherever it could be found, to put on each line shaft a motor large enough to take care of any probable future growth. When the armistice was signed, however, and the necessity for high-speed production became less, the load also became less with the result that the power factor of the entire plant was reduced considerably. Obviously the remedy for low power factor was to reduce the connected horsepower, so tests upon each motor were made in order that all machines be correctly motored. Smaller ones could be installed if needed or they could be re-arranged to operate to the best advantage.

The instruments available for the testing consisted of a portable recording wattmeter, a portable recording power-factor meter, an ammeter with 5-amp. scale, a voltmeter and a tachometer. In addition there were three instrument transformers each with ratios of 100, 50 and 25 to 5 amps. These were connected to the motor line through leads terminating in switchboard plugs. The transformer secondaries are connected—the two outside ones—to the current coils of the wattmeter and the middle one to the ammeter and to the current coil of the power-factor meter, which are in series. In these circuits are placed "broken-back" switches which allow the measuring of current in any phase without opening the secondaries. It was found necessary to meter each phase because the voltage was slightly unbalanced and reading the power-factor meter would be incorrect. By measuring the power-factor of all of the three phases and averaging the readings the true power-factor was obtained. In front of the transformers is a heavy protecting switch and a set of fuses connected so that the fuses are always in circuit whether the switch is open or closed. The portable meters rest on a pad of $\frac{3}{4}$-in. (1.9 cm.) felt, the combination being mounted on a rolling meter table with swiveled, rubber-tired wheels. Nearly all connections are back of the board.

For connecting the current coils of the meter in the line dummy fuses are used. In each end of them are tapered holes reamed to receive the switchboard plugs. With this arrangment it is a very simple matter to

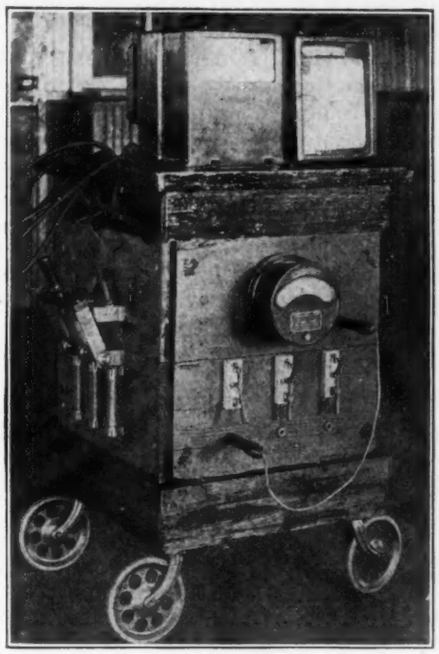


FIG. 1—PORTABLE CART CARRIES METERS AND INSTRUMENT TRANSFORMERS

Potential leads of power-factor meter have test clips attached so that they may be changed to make the meter read correctly. The meter rests on a ¾-in. felt pad.

connect the meter leads to any size of dummy fuse, to take out one running fuse at a time from a motor circuit and to slip the dummy in its place. For con-

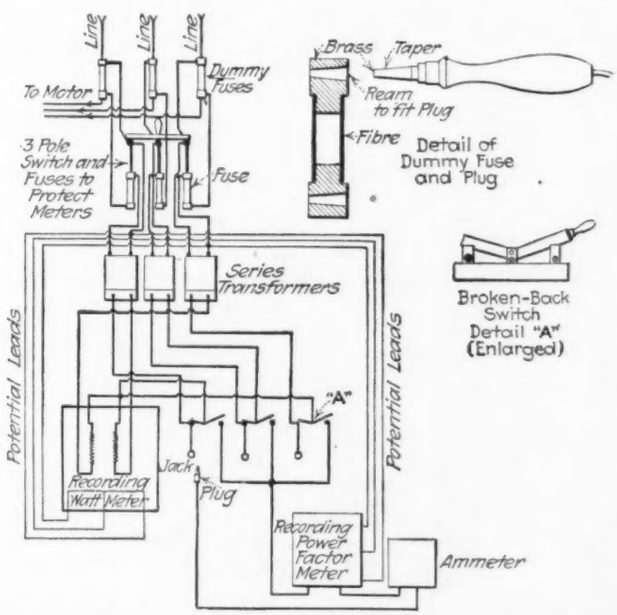


FIG. 2—WIRING DIAGRAM OF METERS AND TRANSFORMERS ON PUSH-CART

venience, and to avoid mistakes, the wooden handles of the switchboard plugs are painted different colors for "line" and "load" so that the wattmeter connections are always correct.

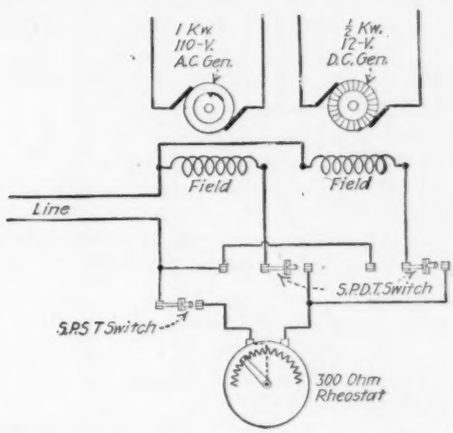
No data is available at this time upon the savings effected because the work is not completed but it has been possible to eliminate more than 150 connected horsepower in the first few months of the test despite increasing power requirements due to greatly increased production. As a matter of fact, production is on the increase and the changing of the motors and fitting them to their loads is responsible for the fact that the power bill has increased only slightly.

THE ROBBINS & MYERS CO., Springfield, Ohio. R. F. MCNETT, Supervisor of Power.

ONE RHEOSTAT USED FOR TWO GENERATOR FIELDS

It Is Employed to Regulate Voltage of Both a 1-kw. 110-Volt Alternator and a ½-kw. 12-Volt Direct-Current Generator

In a motor repair shop located in a 110-240-volt direct-current district a 1-kw. 110-volt alternating current generator and a ½-kw. 12-volt direct-current generator have been installed for testing the repaired motors. As both machines are not used simultaneously one rheostat



SWITCHING THAT PERMITS USING ONE RHEOSTAT FOR TWO GENERATORS

is employed to regulate the voltage of both machines. The generators are attached mechanically to the main power shaft of the shop. The field of either machine may be connected to this 300-ohm resistance or directly to the line by switches as shown in the diagram. The voltage may be varied from 110 volts to 50 volts alternating current and from 12 volts to 5 volts direct current. The actual connections in the shop differ from those shown here in that flexible leads are used in place of the single-pole double-throw switches.

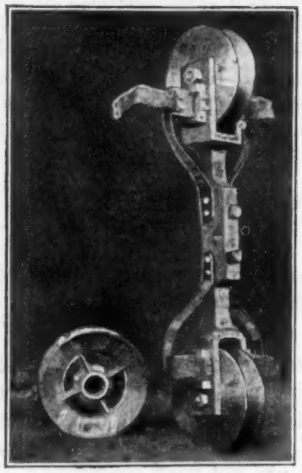
Chicago, Ill. C. W. GODING.

COAL-BRIDGE TROLLEY RE-DESIGNED IN FIELD

Heavy Current Burnt Hub of Skeleton Trolley Wheels Supplied with Bridge so Solid Wheels with Brush Contacts Were Made on the Job

The current for a 9-ton coal-handling bridge operated by the Calumet & Hecla Mining Company was originally collected by two skeleton trolley wheels, but the current in passing to the shaft around which the trolley wheels rotated burned the hubs seriously.

This was caused by the fact that severe service had caused excessive play between the bushing and trolley pin, allowing the formation of arcs. With 800 amp. and a potential of 550 volts the arcing pitted the hubs



SUBSTANTIAL TYPE OF COAL-BRIDGE TROLLEY HARP MADE IN THE FIELD

of the trolley wheels so severely that the bridge had to be taken out of service.

The new trolleys which were designed on the job to meet the requirements of the service, are of cast gun metal with graphite bushings. Solid construction instead of the skeleton form previously used was employed and metal brushes used to collect the current instead of allowing the current to flow from the bushing to the shaft.

Although the new two-wheel trolley harp weighs more and costs more than the one which was furnished with the bridge, the homemade outfit is considered to be more economical.

FRED. E. THERREIN,
Lake Linden, Mich. Chief Electrician.

MEASURING ENERGY WITHOUT TAPPING LINE

Using Main Cable as Ammeter Shunt Obviates Necessity of Interrupting Production when Motor Tests Are to Be Made

Usually when motor tests are to be made in industrial plants production must be stopped until an ammeter or wattmeter is inserted in the line. Various methods have been devised for minimizing this loss such as the use of dummy fuses, but each method usually entails some interruption of the work. Such delaying of work has been completely avoided in one industrial plant by using a millivoltmeter to measure the current. Instead of opening the circuit to insert the meter, the cable to the motor is utilized as a shunt for the millivoltmeter.

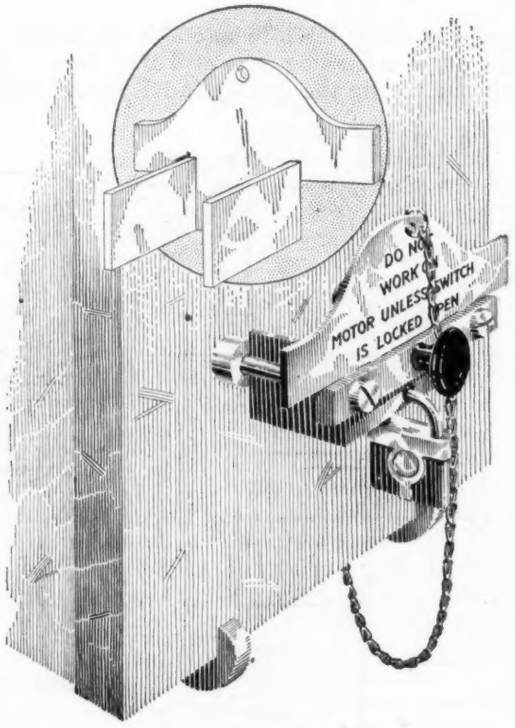
Since the load was known to be about 400 amperes and the available meter (100-millivolt scale) was most accurate near the center of the scale, it was decided to make the length of the cable shunt such that a current of 1000 amp. would cause a full-scale deflection (100 millivolts). This length was calculated from the knowledge that the resistance of the cable [500,000 circ.mil. (253.5 sq.mm.) stranded copper] is 0.0222 ohm per 1000 ft. (0.0728 ohm per km.) at a temperature of about 100 deg. Fahr. (40 deg. C.). In other words to produce full-scale deflection (100 millivolts) with 1000 amp. a shunt resistance of 0.0001 ohm was necessary, or 4.5 ft. (1.4 m.) of cable. The insulation was then removed at points 4.5 ft. apart and the exact distance marked lightly on the conductor with a file. To take readings the meter leads were touched to these two points and the millivolt scale multiplied by 10 to obtain the current.

The accuracy of this method depends upon the temperature of the cable to a great extent, but where a motor is operating continuously the temperature will be fairly uniform. Five degrees Fahr. (2.8 deg. C.) increase in temperature will increase the resistance and the reading 1 per cent approximately.

SAFETY-SWITCH BLOCK PREVENTS MOTOR STARTING

Locking Aluminum Block in Switch Handle Prevents Accidental Closing of Circuit on Which Men Are Working

For the protection of men working on connected motors and lines, an aluminum switch block is being used in the factory of the American Can Company at Chicago. This device is applied to the safety switch of the type having a pull handle fastened to two small iron rods which slide through the face of the switch box. When the block is locked in place the switch cannot be



ALUMINUM BLOCK HOLDS SWITCH OPEN

closed. The usual procedure is to have the foreman insert the padlock and to keep the key. Only when he is assured that all men are off the line can the switch be closed. To prevent loss of the block a chain fastens the block to the switch box.

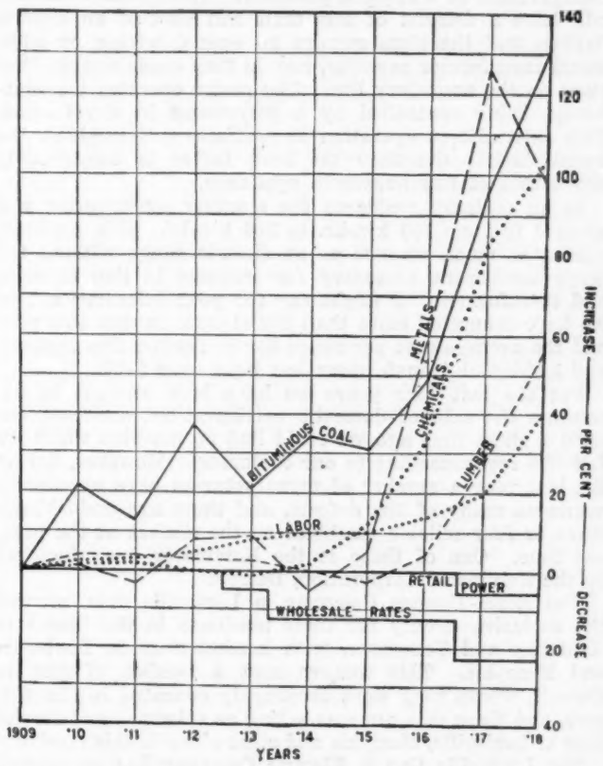
CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Methods for Increasing the Use of Electric Light, Power and Heat

ELECTRIC POWER COST VERSUS COST OF OTHER COMMODITIES

Increased Cost of Factory Materials and Labor Contrasted with Decreased Cost of Central Station Power For Last Ten Years

The decrease in the cost of central-station power since 1909, while prices of practically all other commodities have increased tremendously is shown in the accompanying curves. Even during the World War the power rates



COST OF FACTORY MATERIALS AND COST OF ELECTRICITY

were low. Although these curves include only to the end of 1918, power rates have not been raised in many places, although the cost of everything else has increased since that time.

The factors which made these reductions possible are a gradual improvement of load factor, an increasing volume of business, increased efficiency in generating equipment, and an increase in the density of power users. These same influences are still in operation. Although no one can tell how long they will offset the increase in cost of labor and materials necessary for producing central-station power, they will still continue to keep the cost of power low compared with practically all other commodities.

The curves were prepared from government data by George H. Jones, power engineer of the Commonwealth Edison Company, Chicago, and were presented in a paper read before a joint meeting of the American Institute of Electrical Engineers, the electrical section of the Western Society of Engineers, and the Illuminating Engineering Society in Chicago, Nov. 24, 1919.

FLAT RATES DEFENDED IN CAPE COD HEARING

Central Station Customers Vote Against Establishment of Steam Reserve Plant at Higher Rates Details of Increased Cost

The Buzzards Bay Electric Company, Falmouth, Mass., serves the major portion of Cape Cod south of the Cape Cod Canal, purchasing energy at the Canal from the Southeastern Massachusetts Electric Company, which in turn buys electricity from the New Bedford Gas & Edison Light Company.

During June to September, inclusive, the rate for power, heating and cooking service is 35 cents per kw-hour, and for the balance of the year a discount of 40 per cent is applied, the peak load of the system coming in August. A 5 per cent discount is allowed for 10-day payment, and there is a minimum seasonal charge of $9 which must be paid before service is supplied. Residence lighting is supplied on a flat rate throughout the territory, which covers nearly as large an area as that served by the Boston Edison company. The commercial lighting rates are based on a charge of $1 per month for the first 25-watt unit connected, 80 cents per month for the second, and 60 cents per month for each additional unit of this size, residential capacity being figured at not less than 75 watts or less than one-third of the total watts connected; hotels and boarding houses at not less than two-thirds the connected wattage, and stores and shops at 100 per cent of the connected lighting load.

The company's rates and efforts to provide satisfactory service were defended at a hearing in Falmouth recently by Eugene Carpenter, the treasurer, before the Massachusetts Gas and Electric Light Commission. Considerable dissatisfaction was expressed relative to interruptions of service and various speakers urged that a meter system be installed for commercial lighting users. A circular letter was sent some weeks ago to all customers, offering to establish an immediately available steam reserve service at its 950-kw. Falmouth station, at present shut down, if the patrons were willing to accept a discount of 10 per cent instead of 40 per cent on their bills for the eight non-summer months of the year.

The replies indicated that only 6.5 per cent desired to have the Falmouth steam plant started to float on the system or be held in immediate readiness for service; 8 per cent were undecided or would not object to a cut in the discount for this purpose, and 85.5 per

cent preferred to continue the present rate without putting the Falmouth plant into commission for emergency use.

On behalf of the company it was brought out that many of the interruptions complained of would be eliminated in future by the recent installation of a third 2300-volt submarine cable at the canal crossing, and by increasing the distance between the line wires and the steel towers on the line between New Bedford and the canal district. Plans are also afoot for the sectionalization of portions of the line traversing the Cape south of the canal, to permit segregation of trouble.

Costs of Line Material

An interesting tabulation of the increased cost of line material met by the company between 1912-13 and the present time was presented by Mr. Carpenter, who said in part:

To give an idea of some of the adverse conditions which vitally affected our business we submit a table of 15 items which we use in quite large quantities in making extensions, connecting customers, etc. It will be noted in the total that the present prices (and this does not take into consideration the much higher prices that we were obliged to pay during the war) are 108% more than they were in 1912-13. Present freight rates are more than double.

	Cost 1912-13	Now
35-ft. chestnut poles	$5.25	$11.75
30-ft. chestnut poles	4.00	8.00
Copper wire per 100 lb	15.80	32.25
No. 44 insulators, each	.0368	.1300
Strain insulators, each	.1000	.1565
Cross arm braces	.1908	.3651
Anchor rods	.2148	.4866
12-in. through bolts, each	.0458	.1185
14-in. through bolts, each	.0540	.1323
16-in. through bolts, each	.0851	.1460
Galvanized square washers, each	.0117	.1214
Galvanized pole steps, each	.0357	.0727
Galvanized house brackets, each	.0850	.1900
Galvanized stranded guy wire per 100 ft	.0780	.1875
Locust pins, each	.0220	.0500
	$26.0097	$54.1566

In explanation of the difficulties the company is laboring under in its thinly settled territory, Mr. Carpenter said that the war had brought about a shortage of labor available for transmission line maintenance, and the cost of coal delivered to the company at tidewater on Vineyard Sound had risen from $6.64 to $12.50, with no immediate prospect of any marked reduction. The energy now purchased indirectly from New Bedford costs the Buzzards Bay company about 2 cents per kw.-hr., and about 2,000,000 kw.-hr. will be absorbed at the canal metering point this year. Conditions have now improved in regard to inspection and many of the difficulties encountered over 90 miles of line have been eliminated. Mr. Carpenter said it would cost over $30,000 to install meters throughout the system. About three-eighths of the customers are summer visitors. Last August there were 2751 customers. The gross earnings are $104,760, of which commercial lighting represents $83,077; street lighting, $14,023; and power, $7659. In the course of his statement Mr. Carpenter said:

"Electric service is a highly organized business, differing from any other that we know of in that the demands of the customers are manufactured and supplied instant by instant. This we believe is so in no other line of business; we must wait our turn at stores; we wait for a train, then if it be late we must wait until it has made up its lost time. We wait for our mail; we must wait for the operator and a free line when we telephone; but an electric customer throws in his switch at any minute, night or day, and any day in the month and he must be served with anything that he wishes instantly or our service has failed, at least in part, and we certainly have always endeavored to keep these failures at the minimum point."

The board took the case under advisement.

ELECTRIC REFRIGERATORS AS NUMEROUS AS PIANOS

Central-Station Man Foresees the Day When a Motor-Driven Refrigerator Will Be in Almost Every Home

Central-station men who have been interested in the many attempts to develop motor-driven refrigerators will be interested in the following letter from Robert Montgomery, commercial manager of the Louisville (Ky.) Gas & Electric Company:

For some years we have realized the value of domestic refrigeration as a revenue producer. These little machines will have a demand of less than half that of an electric flatiron and therefore require no special wiring or additional transformer capacity, nor do they cause any fluctuations on the secondary line. The motor operates intermittently, being controlled by a thermostat in the ice-box. This intermittent operation is continuous throughout the twenty-hours; therefore the load factor is considerably above that of any household appliance.

In an ordinary residence the monthly consumption will amount to from 100 kw.-hr. to 200 kw.-hr. This produces almost as much revenue as an electric range without the large investment necessary for increase in line capacity and transformers. I might say for your information that we have connected more than 100 electric ranges this year and the average cost per range for increasing line capacity and additional transformers has been over $150.

For the last four years we have been anxious to encourage the sale of domestic refrigerating machines, but until a short time ago we could find no machine which we felt like recommending to our customers. However, during the last year a number of manufacturers have apparently overcome many of the defects, and there are undoubtedly three or four reliable machines on the market at the present time. One of these is the Kelvinator, manufactured by the Kelvinator Corporation, Detroit.

The Ream-Thomas Company, a Louisville firm, secured the exclusive agency for these machines in the States of Kentucky and Tennessee, with headquarters in Louisville and Memphis. This concern sent a number of men to Detroit, where they were thoroughly educated in the factory, and these men are now acting as salesmen and service men in Louisville, Memphis and other cities in this territory.

The Louisville Gas & Electric Company has no connection whatever with the Ream-Thomas Company, the Kelvinator Corporation or with the sale of the machines other than the co-operation we give to all local electrical dealers who encourage the use of energy-consuming appliances. We do not hesitate, however, to recommend the Kelvinator to our customers, for the reason that one of our own men spent a month in Detroit investigating the machine and while there called at nearly one hundred residences where the machines were in actual operation. The Ream-Thomas company has had one of these machines in operation in the model kitchen of our display room for some time, and it has operated perfectly, without even a minor adjustment.

Six of these machines were sold from our office the first day the machine was put on display, and the Ream-Thomas company is more concerned about the factory furnishing enough machines than about the sale of them.

Personally, I am enthusiastic over the possibilities in domestic refrigeration, for a machine of this charcater is needed in every home in America. Everybody wants the machine; therefore the sale depends entirely upon whether or not the "prospect" is financially able to purchase one. A piano costs as much as a domestic refrigerating machine, and as there must be at least eight million pianos

in the United States, I can see no reason why there should not be eight million domestic refrigerating machines in use. The latter will certainly contribute considerably more to the health, happiness and convenience of the family (and the neighbors), and I understand that the refrigerating machines can be bought on the time-payment plan in most places, the same as a piano.

The Kelvinator Corporation has organized its sales plan along the lines generally used by automobile manufacturers. It sells its machine on sight draft, bill of lading attached, and usually gets 20 per cent down payment on all orders. It has not as a rule picked central stations to distribute its goods but has picked, rather, concerns with specialty selling experience or concerns that will employ men who will specialize on motor-driven refrigerators. In every case, however, the local organization has sought the co-operation of the central station.

A METHOD FOR MAKING FARM LINES PAY A PROFIT

Keep Investment Out of Lines and Charge Enough to Cover 50 per Cent Line Losses Which Data Show Will Occur

BY H. H. HENLEY
Sterling Electric Company

Farmers have been educated to use electricity by the small isolated plant. Now they want something more than the small plant. They want power and the elimination of plant attention. To accomplish this the farmer realizes he must connect to some available power line.

To get power and light on a larger scale than can be obtained from the small isolated plant, the farmer will invest in a service connection an amount of money at least equal to the cost of a private plant. If he would generate as much energy with a private plant as he wants to use from a power line the cost, including depreciation and maintenance, would be much more than he could purchase energy for, even though he paid a flat 15-cent per kilowatt-hour rate.

LIMITED OBLIGATION

In serving this business the central station should not have money invested in farm lines or assume any maintenance obligations beyond the natural life of the pole lines. Transformer core losses should be covered with a high minimum rate or if this is objectionable the metering equipment should be on the primary side of transformers. Statistics which the writer has compiled show that the actual energy used by rural consumers is only 40 per cent to 45 per cent of the energy required for the line. The balance is core loss and transformer inefficiency. It is a fact that a large farm line development gives an ideal load factor on account of the large transformer core losses, but these losses must be paid for.

During this year the writer had been personally connected with the development and installation of a large number of farm lines. In one county, we developed and installed nearly $50,000 of farm services. All of the developments of this county were accomplished by organizing stock companies among the farmers to purchase current wholesale from the central station. On this job, metering equipment is installed at the point of connection to the power line. One of these developments paid the power company over $200 for energy in October on the basis of 4½ cents per three-phase, 2300-volt circuits on 30-ft. (9-m.) poles, three- phase, 2300-volt circuits on 30 ft. (9 m.) poles, with 200 ft. (60 m.) spacing, using No. 6 bare hard-drawn copper conductors. The lines are insulated for future "Y" connection should the load or distance demand it.

Where it is thought advisable for the central station to own and operate a farm line, the farmers served should stand the entire investment unless there are towns beyond that the company wishes to serve. Then it may be advisable for the company to invest only the amount of money in the line that the revenue from the town will support. By this method a great many small towns are served that without taking the farmers into consideration could never support the necessary investment to install a high voltage line to serve them.

We are developing a line at this time that will serve eventually about 400 farmers on a main line which is 60 miles (95 km.) long and 20 miles (32 km.) of single-phase laterals. In this case, seven towns are to be served. Farmers are now entering into contracts to pay $400 connection charge which includes only a transformer located on main line nearest their buildings. The consumer will stand the additional expense of building his secondaries from the transformer to his buildings. The main line will be 22,000-volt, three-phase circuit on 35-ft. (10-m.) poles with 250 ft. (76 m.) spacing, carrying No. 10 bare copper conductors. A single-phase 2200-volt secondary line will be installed on a lower cross-arm to serve the farmers.

INSIST ON STANDARD CONSTRUCTION

This is a flexible arrangement, as the 2200-volt line may be sectionized and additional 22,000/2200-volt transformers may be installed to take care of natural growth. When the single-phase lines leave the main line as laterals they will be constructed to permit adding the third conductor later and raising the potential to 4000-volt "Y".

Single-phase 2200-volt metering equipment will be installed on the transformer pole. It will consist of a meter and current transformer inclosed in a wooden box. No potential transformer is required, as available 110-volt potential can be taken from the secondary side of the transformer.

As to a policy on building these lines it seems best for a power company to insist on standard construction and to refuse to allow the farmers to organize and buy materials and install their own lines. Trouble is sure to result if this is done because when the line is completed it is not likely to equal a good rural telephone line in quality.

Personally the writer prefers lines of lower voltages as standard because less telephone interference exists and because core losses are lower. Eventually an electric service line may be expected on every road in the country where a rural telephone line exists and the industry must get started along the right lines if this business is to be handled at what would be a satisfactory profit.

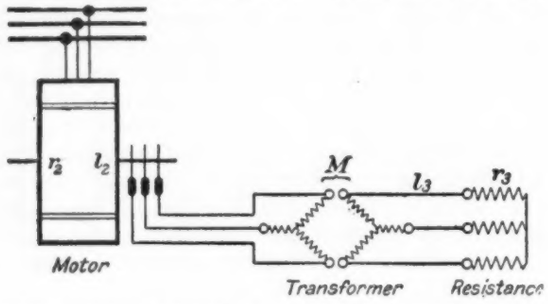
Central stations will find the rural customer not only a ready customer but one that will pay a profit provided he is required to carry the investment and pay for the loss of energy due to distance and the necessary use of individual transformers.

DIGEST OF ELECTRICAL LITERATURE

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Starting of Asynchronous Motors by Means of Tertiary Eddy Currents. — R. RUDENBERG. — Considering methods of arranging induction motors for high starting torque and small slip under load, the author decribes a method which uses the properties of a variable frequency transformer, and this is inserted in the circuit of the rotor and not in that of the stator. The method is shown diagrammatically in the illustration. The secondary circuit of the motor is connected through the transformer with a tertiary circuit, in which a considerable resistance is inserted. When at rest the rotor



FUNDAMENTAL SCHEME OF INDUCTION MOTOR CONTROL

winding receives the full frequency of the network, so that the transformer produces a very small effect on the current. The resistance which is not variable produces almost exactly the same effect that it would if it were directly connected to the slip-rings. It can therefore be of such magnitude as to allow of the generation of a large starting torque. In the neighborhood of synchronism there is, however, a low frequency in the circuit of the rotor. The induction effect through the transformer is therefore lost especially as the resistance is great in comparison to the self-induction. Under these conditions the only effect in the rotor circuit is that produced by the secondary conductor resistance, which is small, so that the tertiary resistance can be regarded as being wholly without effect. The apparent ohmic resistance of this arrangement is therefore automatically dependent on the frequency of the slip. It is a better plan to abandon the use of a transformer, however, to utilize the leakage field of the rotor which exists in every motor. At the start the leakage field is considerable and has high frequency; it is therefore especially useful for producing induction effects. Broad metallic rings may be used projecting at the sides of the rotor. It is still simpler, however, to use the squirrel cage form of construction and to imbed the tertiary conductors in the slot.—The London *Electrician*, Oct. 10, 1919.

A Giant Transformer.—The Allg. Elektr. Ges. have recently completed the work on a transformer for 60,000 kva. to be used at the Goldenbergwerk plant for transformation from 110,000 volt to 13,500 volt. The total weight of the unit is 116,000 kg. and the height is over 17 ft. (5.2 m.). 40,000 kg. of 0.3 mm. transformer plate was used in constructing the core, which has three legs of elliptical section. The winding is of aluminum, and weighs but 4,000 kg. The coil-losses are 434 kw., and the core-loss "only" 126 kw., which corresponds to an efficiency of 99.07 per cent.—*Helios*, Feb. 23, 1919.

Spring Thrust Bearings and Cooling Coils on Large Vertical Generators.—T. W. GORDON.—The author states that for many years one of the limiting features of large vertical machines was the need of a simple thrust bearing. He states that such a bearing has been developed and is in use in the Cedars Rapids power station. The bearings referred to have now been in operation for a sufficient length of time to demonstrate their success.—*General Electric Review*, Nov., 1919.

Designs of Larger Vertical Alternating-Current, Waterwheel-Driven Generators.—M. C. OLSON.—The author calls attention to some of the special features that have to be considered in the mechanical and electrical design of large hydro-electric generators. Such machines are being constructed in sizes up to 32,500 kv.-a. capacity and there seems to be no insurmountable difficulty in building much larger units should occasion demand.—*General Electric Review*, Nov., 1919.

Generation, Transmission and Distribution

Some Fundamentals of Engineering Economics.—D. B. RUSHMORE.—The author sketches the evolution of power as a substitute for human toil. That research and invention be encouraged is emphasized as a condition precedent to our continued development along the lines of material betterment. An interesting summary of the primary horsepower used by the leading manufacturing industries of the country is as follows:

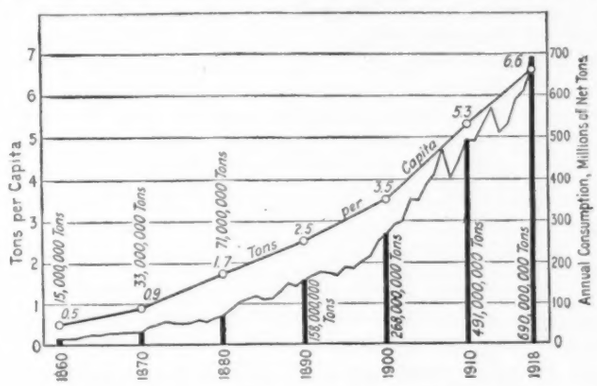
Agricultural implements	121,428
Automobiles including bodies and parts	173,684
Boots and shoes, including cut stock and findings	112,929
Boots and shoes, rubber	24,621
Brass, bronze and copper products	122,700
Bread and other bakery products	107,771
Brick and tile	470,758
Cars and general shop construction and repairs by steam railroad companies	433,994
Cement	490,402
Chemicals	282,385
Copper, tin and sheet-iron products	75,263
Cotton goods, including cotton small wares	1,585,953
Electrical machinery, apparatus and supplies	227,731
Fertilizers	114,281
Flour-mill and grist-mill products	822,384
Foundry and machine shop products	1,129,768
Ice, manufactured	461,988
Iron and steel blast furnaces	1,222,273
Iron and steel, steel works and rolling mills	2,706,553
Leather, tanned, curried and finished	172,712
Lumber and timber products	2,796,902
Paper and wood pulp	1,621,154
Printing and publishing	335,210
Slaughtering and meat packing	260,996
Smelting and refining copper	194,980
Woolen, worsted and felt goods and wool hats	398,367
Total all industries	22,547,574

General Electric Review, Nov., 1919.

Transmission Line Poles of Reinforced Concrete.—M. FOERSTER.—The poles are hollow and are made in lengths of 40 ft. (12 m.) and any desired wall thickness, by pouring mortar into a long wooden form, containing the necessary structure of reinforcing steelbars, the entire form being rotated at high speed in a special cen-

trifugal machine. The normal poles are designed to stand a pull of 400 kg. (880 lb.) with a factor of safety of 4, corner-poles being built double, up to 60 ft. (18 m.) long, and by the same factor of safety, will stand a pull of 3000 kg. (6600 lb.) at the top. Poles of this type are said to be used by the thousands in Germany, and recently 370 were provided for a 25-mile (40 km.) 60-kv-transmission line near Dresden.—*Elektroteknische Zeitschrift*, Apr. 24, 1919.

Power Transmission and Industrial Development.—ROSS J. MCCLELLAND.—The author tells what the functions of transmission systems are and deals with our power resources showing in what directions it is feasible to look for economies. The vital improvements resulting from a far reaching and interconnected transmission system may be briefly summarized as follows: (1) Maximum efficiency of power generation and economy of investment. (2) Bringing within economic range other important measures of national economy such as extensive water power development, railroad electrification and recovery of valuable coal by-products.



THE INCREASE IN COAL CONSUMPTION SINCE 1860

(3) Stimulation of industry generally and development of new specialized industries due to assurance of adequate power supply over the entire region involved. (4) Great extension of areas suitable for industrial development and consequent checking of present tendency toward excessive localization of industry.—*General Electric Review*, Nov., 1919.

Traction

Preventing the Breakage of Armature Leads on Railway Motors.—A. L. BROMALL.—This paper may be summarized as follows:

To overcome trouble with broken leads.

1. Reduce the vibrations as much as possible by (a) discarding badly worn gears and pinions, (b) repairing track having broken joints or bad crossovers which cause severe jolts to the motor, (c) eliminating flat wheels, (d) supporting the motor nose as flexibly as possible, (e) discarding badly worn axle and armature bearings, (f) giving each motor a running test at high speed after being repaired to see that they are not out of balance.

2. Increase the resistance of the armature leads so that they can resist vibration by (a) reducing the possible movement of the leads as follows: (1) Eliminate all cases of loose corse and commutators, (2) locate the leads so that they naturally support each other, (3) hot band the armature, (4) dip and bake in varnish or treat with some other material to cement the leads thoroughly in place, (5) locate the bands so as to give the whole end winding and leads a distributed support, (6) reband the armature after it has been in service and the insulation dried out in order to take up any looseness which may have developed. (b) Strengthening the lead to withstand vibration as follows: (1) eliminate all possible bends, (2) make all bends on as large a radius as possible, (3) do not nick or scratch the leads, (4) remove sharp edges of the commutator slot, (5) surround the copper lead with a thin phosphor bronze sleeve (where the construction permits).—The *Electric Journal*, Oct., 1919.

Comparison of Low-Speed and High-Speed Interurban Freight Locomotives.—D. C. HERSHBERGER.—The writer states that adequate energy supply and the service to be performed are the two important factors which influence the selection of locomotives of proper speed characteristics and hauling capacity. The overall economies are determined largely by the character of service to be performed and the power supply available. A fast engine may economize in time on the road, but lose this advantage by making it necessary to provide additional power equipment and feeder capacity. The low-speed engine may perform the service without additional power equipment, but interferes with passenger traffic in day operation.—The *Electric Journal*, Oct., 1919.

Installations, Systems and Appliances

Main Hoists for Open Hearth Ladle Cranes.—W. W. GARRETT, Jr.—The writer points out the advantages of using two motors in series instead of a single motor. He states that in case of failure of one motor the hoist may still be operated with the other. Other advantages are that it will be easier to reverse the motors as they will have less tendency to race. Braking from two separate units will be more positive, commutation of current peeks will be more easily accomplished and the motors in series will act as a double booster to the line when the hoist is running down. He states that in his opinion the two motor series scheme is by far the safest, cheapest and most dependable.—*Proceedings at the Association of Iron and Steel Electrical Engineers*, Oct., 1919.

Electro Percussive Welding.—ETHAN VIALL.—This method of welding, while nearly fifteen years old, is not very generally known excepting in some electrical concerns, where it is used for joining wires. Its possible uses for many processes in jewelry or similar manufacturing have not yet been extensively tried. The author describes actual tests on two No. 18 B. & S. aluminum wires using an oscillograph which shows that the power being expended at the weld reaches a value of 23 kw. for an instant. However, the entire weld is made in 0.0012 seconds and the total energy used at the weld is 0.0000023 kw.-hr. Cost of this weld, figured at 10 cents per kw.-hr., would be twelve millionths of a cent.—The *American Machinist*, Nov. 13, 1919.

Electrophysics and Magnetism

Surges on a System of Parallel Conductors.—H. M. PLEIJEL.—In what forms the latest link in a chain of articles on the application of Heaviside's operator method to problems regarding surges, or traveling waves, on lines, the author takes up the question of the effect of switching on one line upon the electrical conditions of a neighboring line. If a loaded telephone line (2) runs parallel to a transmission line (1), and a high constant potential is suddenly applied to (1) while the home end of (2) is grounded, there will be

the ordinary charging-surge traveling in over (1), while in (2) *two* waves appear, propagated with different speeds, so that the result is a rectangular voltage impulse, the tail of which travels slower than the head, which causes the impulse to broaden out as it goes along the line. Through reflections at the ends interesting beat phenomena may occur. In general, this holds for ordinary unloaded lines that if the secondary lines are freed at both ends, their presence will not affect the voltage distribution on the primary line, where switching occurs; the currents on the secondary lines will be zero at all points; and the voltages may under all conditions be derived directly from the electrostatic expressions in terms of potential coefficients. If the secondary lines are grounded at both ends, the voltage must be identically zero, and an intermediate ground will have no effect. The theory is extended to cases with alternating e.m.f.s. and expressions are given, which permit of a direct application of the Heaviside expansion theorem to problems of damped alternating voltages.—*Teknisk Tidskrift, Elektroteknik,* July and September, 1919.

The New Physics.—A. C. Crehore.—This is the first of a series of articles by the author dealing with the underlying theory of electricity and magnetism in which he takes up the elementary considerations which lead to the development of the fundamental electrostatic systems and electromagnetic units.—The *Journal of Electricity,* Nov. 15, 1919.

Electrochemistry and Batteries

Electrolysis of Sulphate of Lead in the Storage Cell.—Paul Bary.—If the charged plates of a lead accumulator are put into pure dilute sulphuric acid, very weak discharge effects are obtained. However, if the plates are removed, and put into acid containing sulphate of lead in dissolved form, the normal discharge effects occur. From this and a series of other observations the author draws the conclusion that the electrolysis of sulphate of lead is of vital importance for the action of the lead accumulator cell.—*Revue Général d'Electricité,* Aug. 16, 1919.

Units, Measurements and Instruments

A Graphically Recording Frequency Meter.—Keinath.—The vibrating-reed type of frequency meter cannot be used for graphical recording, nor for the actuating of relays. A special pointer instrument therefore has been devised by the Siemens-Halske A. G. It is a dynamometer with fixed iron cored coils S, and a moving coil with two windings, s_1 and s_2. s_1 is short-circuited through a suitable impedance, and thus furnishes the restoring torque. No directive springs are used. S and s_2 are connected through two condensers, to the mains. At the normal frequency, the currents in S and s_2 are just 90 deg. out of phase, and the moving coil stands at right angles to the field, but when the frequency varies, the phase relations will change, and the coil will deflect. The meters are made for normal frequencies from 10 to 10,000 p.p.s. with ranges from 2 to 5 per cent, are independent of temperature, and are claimed to be practically free from errors due to a variation in voltage of 10 per cent.—*Helios,* March 9, 1919.

Telegraphy, Telephony, and Signals

Propagation of Telegraphic Impulses on Loaded Lines.—R. Holm.—Expressions for voltage and current at a given point on an infinitely long smooth line are derived by integrating the equation of propagation by the Riemann method. The results are shown in a series of diagrams for particular cases. The problem of a periodically loaded line is then attacked, approximate expressions for the form of the wave front being arrived at by a consideration of the successive deformations of the wave in passing from one loading coil to the next. A method for estimating the inaccuracy of the result is given.—*Archiv für Elektrotechnik,* Feb. 7, 1919.

A New High Power Telephone Transmitter.—A novel type of carbon granule transmitter, designed to have especially good cooling, and employing several co-acting microphone-buttons, has been developed by the Swedish Tagtelefon Company, with a view to providing a reliable high-current transmitter for moving train telephony. In order to obtain high amplitude of vibration over a relatively large surface, the diaphragm is made of rectangular form, and is clamped along two edges, while the other two edges are free to swing. The microphone-buttons are placed in a row, in the middle part of the diaphragm, where the amplitude is a maximum. The mouthpiece is of a peculiar form, and directs the incoming sound waves in a symmetrical way against the diaphragm, thereby avoiding the occurrence of higher modes of vibration. The microphone may be directly adapted to the standard Swedish telephone apparatus, the transmitter, when in use, being plugged to the direct-current lighting mains.—*Elektroteknisk Tidskrift,* May 1, 1919.

Use of Three-Electrode Vacuum Tubes for Radio Telegraphy and Telephony.—C. Gutton.—As a continuation of a previous article on the theory of vacuum-tube oscillators, the author here gives a description of the electrical arrangements of vacuum-tube transmitting sets for radio-telegraphy, used in France during the war. A discussion of the advantages of heterodyne reception is given, and of the application of vacuum-tubes to radio telephony.—*Revue Général d'Electricité,* Sept. 20, 1919.

On the Goniometric Functions Applicable to Directive Aerials.—A. Blondel.—The writer indicates the manner in which the phase differences of the electromotive forces induced in the two vertical or nearly vertical parts of the measuring aerial necessitates important corrections, when the dimensions of the loop or frame are not very small compared with the wave length employed. It is important to study these in order to realize the difficulties which attend the use of short wave lengths in the radiogoniometric work. This is the first issue of the *Radio Review,* of which it is said to be the sole aim to record the scientific developments in radio telegraphy and of those branches of allied sciences which are related to that subject.—The *Radio Review,* October, 1919.

Rapid Telegraphy.—Montoriol.—The article deals at great length with the various systems for automatic telegraphy and multiplex telegraphy in use and discusses their practical applications and limitations with especial reference to the traffic conditions obtaining in France. A critical comparison of different systems leads the author to the conclusion that the French Baudot system is superior to, or at least as good as any of the English or American systems for high speed telegraphy.—*Bulletin de la Société Française des Électriciens,* June, 1919.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

News in Brief

Summary of Important Happenings in the Industry During the Week

At the beginning of the new year the electrical industry, having taken stock, finds that it has carried some of its problems forward from 1919. The enormous 1919 totals of business make an impressive record and every effort will be made to excel them in 1920. Heavy demands for production are reaching all branches of the industry and the manufacturers, central stations and distribution organizations will stimulate their powers to the utmost to provide the needed materials and service. There is no disposition in the industry to minimize the difficulties ahead, but there is strong purpose to meet them squarely and to work them out sanely and with satisfactory results to the companies and workers as well as to the great consuming public on whom the welfare and progress of all really rest.

Stockholders of the Consolidated Gas Company of New York have authorized a new issue of $25,000,000 of 5-year 7 per cent convertible bonds. They are secured by deposit as collateral of $35,000,000 capital stock of the New York Edison Company. The issue has been underwritten by the National City Bank, New York, and is offered to stockholders for subscription.

The South Norwalk Electric Works of the Second Taxing District of the City of Norwalk, Conn., has increased its rates. Its reason is the "continued and advancing high cost of the essentials requisite to the production and supplying of electrical energy."

On Dec. 30 the Electric Club of Chicago voted to lease permanent club rooms in the Morrison Hotel. What was the country's largest electrical lunch club, with a membership of 800, graduated by this move into permanent quarters. The club will have its quarters furnished with up-to-date equipment at an annual rental of $15,000. The club dues will be raised from $5 to $30 per year.

In the week ended Dec. 20, according to the report of the United States Geological Survey, the production of bituminous coal amounted to 86.4 per cent. of normal.

The Merchants' Heat & Light Company, Indianapolis, has given its employees of six months' service or more life insurance policies of $500 to $1,500, according to the term of employment.

In the opinion of H. M. Byllesby & Company, the year 1920 will witness a continuation of the present commercial prosperity, marked by industrial expansion and construction activities.

The National Industrial Conference Board finds that there has been an increase of 80 per cent to 85 per cent in the cost of living between July, 1914, and November, 1919. The board finds an advance of 10.4 per cent since November, 1918, and of 13.5 per cent since March, 1919. Clothing shows the largest increase, 135 per cent and food is next with 92 per cent.

With the Christmas purchasing over, jobbers are giving more attention to their regular supply lines. Seasonal goods upset the electrical market to some extent, but jobbers' shelves are virtually cleared of all their stock of that material so they will have little to hold over till next season. Shipments are bad on flexible non-metallic conduit, flexible armored conductor and low-voltage porcelain, but are better on some schedule material.

Price advances have occurred in condulets, fir cross-arms, safety switches and some line hardware. Certain jobbers have advanced their prices on porcelain because of the short supply. Wire stocks are in fair shape.

Heavy building reports are coming in from virtually all districts, placing 1919 building far above that for any previous year and predicting even greater work in the year just opening. Over $14,000,000 has just been appropriated by the City of New York for 14 new piers at Staten Island.

In its end-of-the-year review of business and crop conditions the committee on statistics of the Chamber of Commerce of the United States predicts sustained industrial activity. The committee emphasizes the hopefulness of the manufacturing industry generally, which although encountering constant labor troubles and shortage of fuel and materials, has orders in excess of its capacity for production within any reasonable time.

The Supreme Court of the State of Illinois has affirmed the decision of the lower court holding that the Illinois Public Utilities Commission has authority to fix rates regardless of rates fixed by franchise ordinances.

The advisory committee conducting the California Electrical Co-operative campaign advises that bonuses be paid to the sales force in order to encourage wider sale of electric appliances.

It is announced in London that a scheme of imperial wireless communication is being prepared under supervision of the Secretary of the Colonies. It is stated that the plan is to link up all of Britain's overseas possessions for commercial purposes.

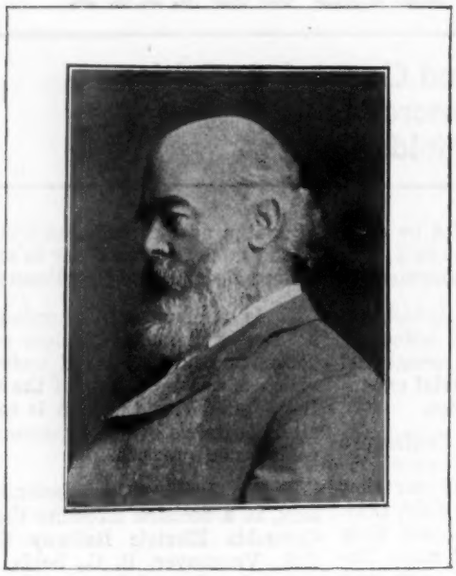
Public Utility Commissioner Retallack, in a decision affecting the British Columbia Electric Railway Company, Ltd., Vancouver, B. C., holds that the principle of requiring security or payment from the consumer for an extension involving a cost greater than the usual outlay of supplying one consumer and out of proportion to the revenue to be derived is a just and reasonable one.

Among the large projects contemplated throughout the country are: The construction of a large steam-driven power plant at the Ludlowville, N. Y., plant of the International Salt Company, 2 Rector Street, New York, N. Y., to cost with equipment about $250,000. Contract has been awarded to R. H. Beaumont, 315 Arch Street, Philadelphia, Pa.

A company has been incorporated to operate the first all-electric steel mill in the country, construction of which will begin in February. The plant is to be located on a site between Girard and Warren Streets, Youngstown, Ohio, which is to be the base of a larger plant later, and will be equipped with two electric smelters and will also have 10 and 16-in. rolling mills. The company is capitalized at $1,500,000 and proposes to manufacture finer grades of steel, vanadium, chrome and nickel steel, for use in automobile parts, locomotive parts and cutlery. L. J. Campbell, formerly vice-president of the Youngstown Sheet & Tube Company, will have charge of the plant.

A collection of about 230 samples of electrical supplies of German, Japanese, Chinese, Danish, English and Argentine manufacture has been placed on exhibition in the rooms of the Associated Manufacturers of Electrical Supplies, New York. These samples were gathered by agents of the Bureau of Foreign and Domestic Commerce in South America, the West Indies, Japan, China, New Zealand and Vladivostok. After correspondence between the Bureau and Charles E. Dustin, general secretary of the Associated Manufacturers, they have been loaned to the organization of the Department of Commerce.

SIR OLIVER LODGE



The eminent English scientist and lecturer on electrophysics who it is announced will make a visit to this country in January. He will lecture during his stay in the United States.

BYLLESBY & COMPANY LOOK FOR PROSPERITY IN 1920

Forecast a Large Amount of Construction in the New Year to Meet the Expanding Demand for Electrical Energy

A review of conditions during 1919 has been issued by H. M. Byllesby & Company. In their opinion the year 1920 will see a continuation of the present commercial prosperity, marked by industrial expansion and construction activities. They say in part:

During 1919 H. M. Byllesby & Company lodged its large engineering and management business in a distinct but closely allied organization—the Byllesby Engineering and Management Corporation—and extended its scope as an investment house underwriting and dealing in diversified securities, including the financing of industrial enterprises. In addition to the New York offices, branches were acquired in Boston, Providence, Madison, Wis., and Evansville, Ind.

The year witnessed the firm's entry into the oil business, in the acquirement, through Standard Gas & Electric Company, of the majority common stock interest of Shaffer Oil and Refining Company.

In the past the Byllesby interests have been identified with the financing, development and management of electric and gas companies, particularly the former. All of the companies will be conducted broadly, as in the past, as subsidiaries of Standard Gas & Electric Company. Their record during the war was highly creditable from the standpoint both of the investor and the consumers served in the 460 cities and towns with 2,200,000 population in 16 states. These companies in 1918, by means of additional volume of business and rate increases, held their net earnings about even with the preceding year, despite unprecedented advances in operating expenses. In 1919 the volume of business continued to increase rapidly and there was a pronounced gain in both gross and net earnings.

During the war and reconstruction periods the customer-ownership, or home financing, policy which the Byllesby companies popularized, proved invaluable as a method of supplemental financing for additions and extensions to the properties. The improvements enabled the taking on of large quantities of new business, and the latter made it possible to increase earnings. In the meantime the original purpose of customer-ownership—the bettering of relations with the public—has also been successful.

During 1919, up to and including Dec. 24, Byllesby companies sold $3,220,100 of their preferred stock direct to customers, the number of sales for the year being 5,356, or an average of a little over six shares to an investor. Compared with 1918, this is an increase of 47 per cent in the volume of stock sold and 24 per cent in the number of purchasers.

The volume of service now demanded from the electric companies is crowding generating and transmission capacities to the limit. This means a large amount of construction during 1920. At the Byllesby properties not far from 85,000 horsepower additional in steam turbine generating equipment is to be installed.

Well managed electric and gas companies have amply proven their stability under the most extraordinary conditions, their ability to confine increases in selling costs to a much smaller margin than the increased prices of commodities and wages, their power to obtain new capital for enlargements and their title to the full confidence of the investor. They also bear the distinction that no charge of profiteering can successfully be brought against them.

15,000 HP. WATER POWER DEVELOPMENT IN WISCONSIN

Plant to Supply 45,000,000 Kw.-Hrs. per Year to Several Cities in Northern Wisconsin and Michigan Will Operate at 68 Ft. Head

The Big Falls (Wis.) Water Power Company, L. E. Myers, president, is about ready to proceed with the construction of a dam and power house at Big Falls, Rusk County, Wis., for the purpose of converting into electrical energy the large water power at that place which has never yet been developed. The Big Falls of the Flambeau River located about 14 miles (22 km.) upstream from Ladysmith, Wis., consists of three pitches, all within a distance of about 0.75 mile (1.2 km.). It is proposed to construct the dam in such a manner as to take advantage of the fall in these three pitches, obtaining thereby a head of about 68 ft. (21 m.) feet.

The drainage area above Big Falls is about 1900 sq. miles (492,000 hectares), and a careful study of the stream flow data available for several years indicates that it will be possible to deliver to the various points of consumption about 45,000,000 kw.-hrs. per year after allowing for losses of generation and transmission.

It is proposed to install four generating units of 5,000 hp. ultimate capacity each with the necessary auxiliary equipment. The power will be transmitted over a double-circuit three-phase transmission line to Ladysmith, Wis., Ashland, Wis., and to the Ironwood and Bessemer Railway and Light Company, which serves several communities in Wisconsin and in the Northern Peninsula of Michigan.

Test holes sunk at various points on the site of the proposed dam show that foundations can be obtained on solid rock. The stream at this point is confined within high rock walls which offer an opportunity to build a substantial structure at a cost which it is said will make the enterprise profitable.

The companies to which this power will be delivered are already operating several steam and hydraulic plants, and it is expected that the combination of these various units with the proposed plant at Big Falls will result in important operating economies.

SIGNAL CORPS WAR WORK WAS BASED ON AMERICAN PRACTICE

Major General Squier Reports on the Accomplishments of the War Period and Pays Tribute to American Commercial Methods

Many interesting facts are given in the report of Major General George O. Squier, chief signal officer of the Army, rendered to the Secretary of War and covering the fiscal year 1919. Certain developments of the two preceding fiscal years which could not be disclosed previously on account of the war are also described.

Prior to the entrance of this country into the war General Squier came to New York and had a conference with Theodore N. Vail and John J Carty, American Telephone & Telegraph Company, and Newcomb Carlton, Western Union Telegraph Company. The problem was discussed of how men and equipment could be picked from these organizations and similar utilities without crippling essential service in the United States. Immediately upon the outbreak of the war several of the leading engineers and executives in the commercial telephone and telegraph companies were commissioned and they began the active work of selection and organization in their own offices. With the loyal co-operation of the companies it was possible to send to Europe in the first months of the war twelve battalions of the best-trained men this country could produce.

General Squier calls special attention to the extent to which specialization has gone under the impetus of war in the matter of electrical intercommunication. The special laboratory fully equipped for radio development at Little Silver, N. J., grew to be one of the largest in the world and the site has been recommended for purchase for the permanent use of the Signal Corps.

TRIBUTE FROM GENERAL PERSHING

The following tribute to the Signal Corps by General Pershing is included in the report:

Now that active operations have ceased, I desire to congratulate the officers and men of the Signal Corps in France on their work, which stands out as one of the great accomplishments of the American Expeditionary Forces—the result of a happy combination of wise planning and bold execution with the splendid technical qualities of thousands of men from the great commerical telephone, telegraph, and electrical enterprises of America. It is a striking example of the wisdom of placing highly skilled technical men in the places where their experience and skill will count the most.

In discussing radio progress during the war General Squire says:

The big development was of the vacuum tube used extensively in practically all modern radio apparatus. Previous to the war all vacuum tubes were strictly a laboratory proposition, impossible to produce in quantity and of an almost prohibitive cost. No facilities existed for quantity production either in the United States or abroad. Certain manufacturers had been experimenting in a private capacity with ballast lamps and regulator tubes in a small way. Believing it the part of wisdom to avail itself of even such limited experience and facilities, the Procurement Division entered into negotiations toward the development of various types of such vacuum tubes as a commercial production. Prices of the tubes in the beginning were an unknown quantity, but subsequent manufacture and competition between two or three concerns standardized the cost to the government of the various tubes running from $1.50 for the cheapest up to $11. Satisfactory production and delivery was being obtained at the time of the armistice.

MAINTAINING UNINTERRUPTED COMMUNICATION

In view of the necessity of maintaining uninterrupted electrical communication between Washington and the American Expeditionary Force, notwithstanding possible enemy activity, various measures were considered. The report says in part on this subject:

The studies which were conducted and the experiments and tests which were made in the United States were numerous and many of them highly scientific in character. In general, the problem consisted, first, in providing radio stations of sufficiently high power to secure the best attainable signals even under favorable conditions; second, in finding measures to insure continuity of radio service at times of serious static disturbances; and, third, to devise plans whereby, in the event of intentional interference on the part of the enemy, the radio signals might not be confused or obliterated by arbitrary signals transmitted for the purpose from high-power enemy stations.

To meet the first condition the Navy Department undertook to complete, as rapidly as possible, a new high-power station at Annapolis, Md., and to rapidly increase to the fullest extent practicable the power of all of the existing trans-Atlantic stations. In addition to this, the Navy designed and undertook the eretcion of a high-power station near Bordeaux, in France, which was intended to be the most powerful station which had yet been constructed.

To meet the second condition, tests were made by the Navy at various naval radio stations on the Atlantic coast to determine those locations in which the least static disturbances were likely to prevail. Corresponding investigations were made on an extensive scale by the Signal Corps, which sent numerous expeditions to different parts of the United States to make electrical and meteorological observations; to determine the intensity of static disturbances and their relation to meterological conditions; the degree of intensity of signals received; and to get all other scientific data obtainable, which might bear upon the problem.

To meet the third condition, intentional interference, numerous scientific methods were tested and studied at the Navy stations and elsewhere.

As a result a comprehensive plan was adopted whereby, in case of necessity, receiving stations at Newfoundland in the north, and along the Atlantic coast of the United States and elsewhere, and throughout the United States as far west even as the Pacific, might be employed.

A second phase of the transatlantic communcations' problem consisted, not in preventing the enemy from interrupting our communications, but in determining in what manner and to what extent the enemy countries themselves were utilizing transatlantic electrical communications.

A third phase of these transatlantic communications was developed by the Chief Signal Officer, who directed Colonel Carty to study the possibility of sending messages in plain English from the War Department at Washington to the American Expeditionary Forces in France and England in such a manner that they could not be intercepted by the enemy, the object of this being to save valuable time which was being consumed in coding and decoding cablegrams.

Colonel Carty undertook this study as directed and gave his attention, first, to the remarkable printing telegraph system which had recently been perfected in the United States.

At the request of Colonel Carty the engineers of the American Telephone & Telegraph Company continued their researches into the possibility of obtaining secrecy by some modification of the printing telegraph. These engineers, co-operating with Lieut. Col. J. O. Mauborgne, Signal Corps, conducted a series of experiments, and finally devised apparatus whereby a message written in plain English could be quickly enciphered, printed in plain letters upon a page similar to the printing of a typewriter, and

transmitted over a telegraph line and received at the distant end. This printed cipher telegram being copied upon the deciphering machine will finally appear in plain English.

The cipher produced by this apparatus when used in accordance with the method of the Signal Corps has thus far successfully resisted all the efforts of cipher experts to break it.

An interesting chapter is devoted to the telephone and telegraph system of the American Expeditionary Forces. In part this story is as follows:

The problem presented by Colonel Russel [of the American Expeditionary Forces.—Eds.] was the construction of a telephone and telegraph line 400 miles long, extending from the west coast of France and across that country to some point not given, and to construct this line so that it might fit into an ultimate telephone and telegraph system extending to distances and places in the British Islands and on the Continent of Europe at that time unknown.

Notwithstanding that very remarkable results had been obtained in America with the new apparatus and methods which had recently been developed for long-distance telephony and telegraphy, these methods and this apparatus were of such recent origin, and so scientific and complicated and delicate in their working, that the propriety of specifying them for use in the theater of war presented a grave problem for decision. While they had given good results in the United States, these results were obtained under conditions where they were under the care of large numbers of well-trained, scientific personnel, and where repair parts, renewals, and shop experts, and manufacturing resources of all kinds were immediately available. None of these favorable conditions existed in Europe. In fact, so new were the methods and apparatus that they were not even known to the European nations.

Furthermore, the strain imposed upon signaling systems by the unavoidable conditions of war presents obstacles never encountered during commercial operations.

After considering the whole question in conference with Colonel Carty, Colonel Russel, notwithstanding all of the complexities and difficulties of the situation, decided to adopt in toto the latest American scientific methods. This decision was of fundamental importance. It was an expression of confidence in American enterprise and scientific skill. While it involved numberless possibilities of failure, if carried to a successful conclusion it promised brilliant results.

Instead of using the heaviest gage of telephone wire, wire of half the weight of copper per mile was decided upon. Instead of loading start coils, a new device, the telephone repeater was chosen. In view of the absolute necessity of obtaining the maximum traffic over each wire, it was decided to build the lines so as to employ phantom circuits. It was decided to adopt the composite system of simultaneous telephoning and telegraphing whereby each of the two wires which composed a telephone circuit may be employed as a duplex telegraph circuit without interfering with the telephone conversations.

Another method, the simplex, was also specified, whereby the two wires of the telephone circuit might both together be employed for any form of telegraph which might be required. In addition to this, a form of printing telegraph just perfected was included in the plans. In its practical working this printing telegraph was found to solve the great problem of shortage of skilled Morse telegraph operators, which was continued until the end of hostilities.

With the adoption of all of these radically new devices, it was evident that only by the providing of most expert personnel and by complete co-operation of the office of the Chief Signal Officer of the Army at Washington with the Signal Corps in France could success be assured. Notwithstanding many serious difficulties, the necessary personnel and apparatus was provided, and the results which were obtained by those in charge of the telephone and telegraph system, American Expeditionary Forces, were in the highest degree successful and exceeded all expectations.

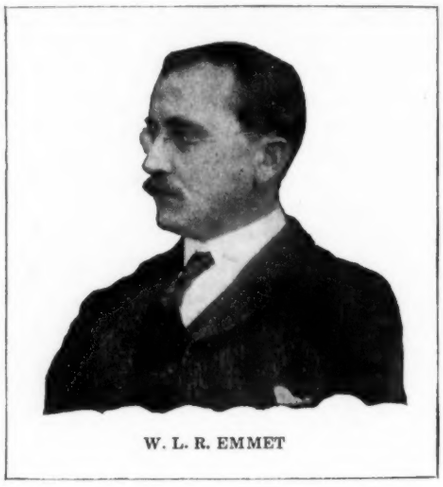
Further extracts from the report of General Squier will be printed in a later issue of the ELECTRICAL WORLD.

W. L. R. EMMET IS AWARDED THE EDISON MEDAL FOR 1919

Consulting Engineer Receives the Honor "For Inventions and Developments of Electrical Apparatus and Prime Movers"

W. L. R. Emmet, consulting engineer of the General Electric Company, has been awarded the Edison medal for 1919 "for inventions and development of electrical apparatus and prime movers." A formal report of this action has been made to the board of directors of the American Institute of Electrical Engineers by the Edison medal committee. The medal will be presented at a later date.

Award of this medal is made annually by a committee of 24 Institute members "for meritorious achievement



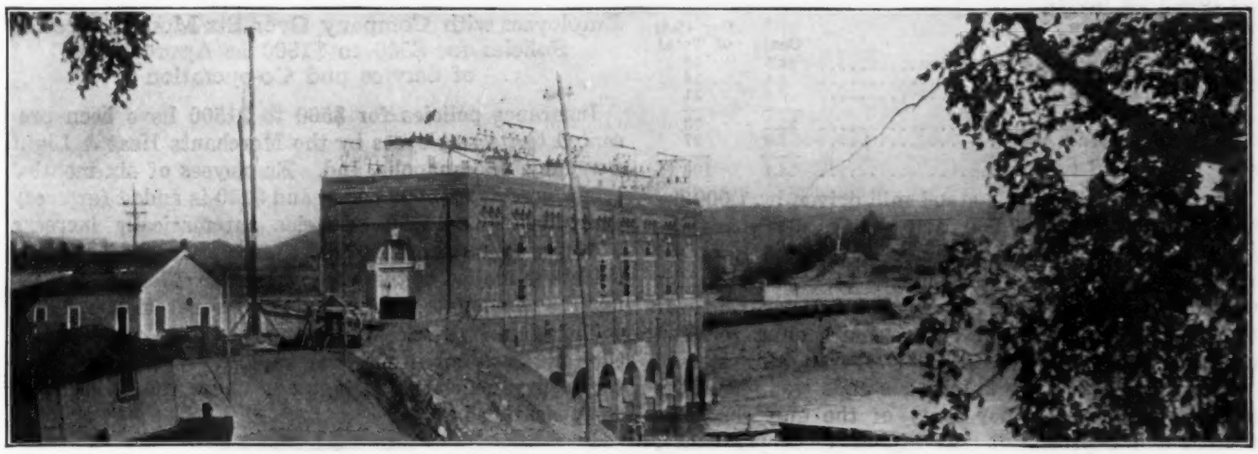
W. L. R. EMMET

in electrical science, electrical engineering or the electrical arts." The medal was founded by the Edison Medal Association, composed of friends and associates of Edison.

Mr. Emmet was born at Pelham, N. Y., on July 10, 1859. He was graduated from the United States Naval Academy in 1881. During the Spanish-American war he re-entered the navy and served as navigator on the U. S. S. *Justin*. His principal civil employment has been with the Sprague Electric Railway & Motor Company and the General Electric Company. He has made a number of inventions and has taken a large part in development. He is known internationally for his activities in furthering the application of electrical energy to ship propulsion. Frank J. Sprague stated in an interview printed in the ELECTRICAL WORLD in 1916 that the development of electric ship propulsion was due more to the individual efforts of Mr. Emmet than to anybody else.

WE HAVE seen examples of government operation of public utilities and should be convinced that in a democracy private initiative and management, fairly regulated or supervised, will continue to be the more progressive and efficient, leaving government to exercise its proper and limited function of administering the laws to protect lives and property and assure, in so far as humanly possible, an equal opportunity for all to enjoy the fruits of labor by brain and brawn.—*Herbert A. Wagner.*

Vernon (Vt.) Hydroelectric Plant of New England Power Company



Present capacity, 20,000 kw. in eight 2500-kw. units; extension rating, 12,000 kva. in two 6000-kva. units. This is the first plant built by the company, about a decade ago, on the Connecticut River between the Vermont and New Hampshire shores about 6 miles south of Brattleboro, Vt. It is the largest hydroelectric station of the system, which, however, has grown to an installed capacity totaling about 100,000 hp. The stations of this system save the burning of nearly half a million tons of coal annually in New England.

STEAM VS. ELECTRIC DRIVE IN STEEL ROLLING MILLS

Mill Representatives Speak in Superlative Terms Regarding Advantages of Motor Drive—Valuable Cost and Performance Data Presented

"Steam versus electric drive in steel mills" was a topic that brought forth considerable valuable discussion at the Pittsburgh meeting of the Association of Iron & Steel Engineers, on Saturday evening, Dec. 20. Practically all of the remarks which were made pointed to the superiority of motor drive, and it is interesting to note that the steel mill representatives who spoke gave it their hearty and sincere support backed by performance data and cost records.

From an electrical point of view the most interesting discussions were contributed by G. E. Stoltz, Westinghouse Electric & Manufacturing Company, K. A. Pauly, General Electric Company, Mr. Sieberts, Bethlehem Steel Company, and E. S. Jeffries, Steel Company of Canada. Others took part in the discussions but their remarks pertained to performance of steam-driven mills only.

Mr. Stoltz presented some interesting motion picture comparisons of steam and electric drive and emphasized the principal advantages of the latter. He called attention to one steel mill where steel was formerly rolled for $1.08 per ton with steam drive, that is now doing the work with motor drive for 27 cents per ton. The electric drive will justify itself in 3¼ years and after that will pay an income of $100,000 a year. In one of the Youngstown reversing roughers one pass is made every 3⅓ sec. with electric drive.

Mr. Sieberts showed some curves indicating the speed variations, work done and utilized, acceleration losses, etc., in engine-driven mills which permitted some interesting analyses and conclusions. He called attention to the shortage of comprehensive data on performance of rolling mills but referred to one installation where the relative unit costs were 76 cents per ton for electric drive and $1.33 for steam. This difference will permit a saving of $684,000 a year in this particular mill. Space economy was referred to as one of the chief advantages of electric drive.

While motor-driven rolling mills, so far, do not roll so high a tonnage as engine-driven mills, there is no reason why they can't, in Mr. Pauly's opinion. In fact, it is on this basis that they will be used still more extensively because the economy and convenience of using them is pretty well known already in a general way. Inertia of rotating mass is the inherent handicap of motor-driven mills, but despite this motors at the Trumbull Steel Company's plant can reverse from 90 r.p.m. in one direction to 90 in the opposite in 3 sec., while at one of the Bethlehem Steel Company's plants the motors reverse from 94 to 94 r.p.m. in 2 sec. At the former plant 20 x 22-in. (50 x 55-cm.) ingots have been rolled to 6½-in. (16.5-cm.) billets in 57½ sec. At the Sparrows Point plant of the latter company, 21 x 43-in. (53 x 109-cm.) ingots weighing 16,500 lb. (7,480 kg.) have been rolled to 10 x 38-in. (25 x 97-cm.) slabs in 1 min. and 38 sec. From the same stock the motor-driven mills have rolled 330 tons of 10 x 40 in. (25 x 100-cm.) slabs in 1 hr.

Some very valuable cost and performance data were presented by Mr. Jefferies taken over a period of 6½ years under actual operating conditions. He also recited the opinions of works manager, master mechanic, vice president and others at the Hamilton, Ont., plant of his company, all of whom spoke most highly of electric drive for rolling mills. For a 34-in. (86-cm.) reversing mill turning out finished billets measuring about 5 x 5 in. (12 x 12 cm.) the total length of delays with the electrically driven mill for the last 4½ years has been only 11 hr. and 35 min., or 1 min. for every 2,000 tons rolled. The energy required for rolling was only about four times that required for the auxiliaries. Including all power cost, maintenance overhead, etc., the unit cost is only 32.7c. per ton; 32.1 kw.-hr. were required per net ton.

For the entire period of 6½ years, the first year

and a half of which was spent in getting on a normal operating basis, the expenses ranked about as shown in the following table:

	Cents	Per Cent of Total
Average total operating cost per ton	16.8	49
Interest on investment per ton	4.6	13
Depreciation per ton	3.8	11
Total main drive expense per ton	25.2	73
Miscellaneous expense per ton	8.9	27
Total	34.1	100

For a 18-in. (46-cm.) 4-stand mill driven by 1,600-hp. motor and rolling 697,000 net tons in 6½ years the unit expense per ton was 22c. Of this 1.3 per cent was for repairs and maintenance, 11.3 per cent for labor, 76.8 per cent for power and 8.6 per cent for interest and depreciation. The repairs on a rod and wire mill having ten 12-in. (30-cm.) roughing stands, and six 10-in. (25-cm.) finishing stands was about the same percentage (1.7 per cent) of the unit cost, but interest and depreciation ran higher (15.9 per cent), labor lower (4.4 per cent) and power cost about the same (78 per cent).

In general the chief advantages of motor-driven rolling mills are low cost of maintenance, and operation, relatively small delays, small stand-by expense, facility with which they can be started, ideal control, constant turning moment and low real estate charge incurred.

LARGER TOTALS IN THE BITUMINOUS COAL OUTPUT

Geological Survey Reports Production at 86.4 per Cent of Normal During the Week Ended Dec. 20—General Resumption of Work

According to the report of the United States Geological Survey the production of bituminous coal was at 70 per cent of normal on Dec. 15. The situation continued to improve throughout the week ended Dec. 20, the output for the week as a whole amounting to 86.4 per cent of normal. The trend of production during the period of the strike ranged from 29.6 per cent of normal in the first week, Nov. 2, to 48 per cent of normal in the week ended Dec. 13.

The total output (including lignite and coal coked) in the week ended Dec. 20 is estimated at 10,431,000 net tons. The average during the four weeks immediately preceding the strike, which may be regarded as normal, was 12,089,000 tons.

Compared with the week before, the output showed an increase of 4,631,000 tons, or 80 per cent. The recovery is the more significant when it is realized that in a single week the bituminous industry climbed from the depression of the strike period to a level of production higher than that of any week from mid-January to mid-August of the past year. Indeed, unless later returns cause a downward revision of the estimates, the curve of 1919 production has again crossed that of 1918.

The recovery was made possible by a general resumption of work in the fields which had been shut down by the strike. The final vote by which the United Mine Workers accepted the President's proposal was taken on Wednesday afternoon, Dec. 10. The following day many men returned to work in the Middle Appalachian region. The movement of resumption resembled a great wave, traveling westward from the Appalachians to the Mississippi.

CENTRAL STATION GIVES ITS EMPLOYEES FREE INSURANCE

Employees with Company Over Six Months Receive Policies for $500 to $1500 as Appreciation of Service and Co-operation

Insurance policies for $500 to $1500 have been presented to its employees by the Merchants Heat & Light Company, Indianapolis, Ind. Employees of six months' service receive a $500 policy and $100 is added for every year above this. The policies automatically increase $100 yearly until a $1500 maximum is reached. A certificate is mailed to the employees with a letter expressing the company's appreciation of co-operation.

This free insurance does not necessitate an examination and does not in any way replace possible payments for injury which would be made under the Workmen's compensation law.

GROUP LIFE INSURANCE FOR GENERAL ELECTRIC EMPLOYEES

Those Employees Having Dependents, Who Have Been in Service One Year or More, Will Receive Policies of $500 to $1,500

The General Electric Company has announced a group life insurance plan for all employees. Every employee of one year or more will have life insurance without cost to himself, regardless of age, sex or physical condition. All of the plants of the company and of its various subsidiary corporations are included in the arrangement under which the free insurance is provided.

Upon the lives of employees who have dependents the insurance is: $500 for one year's service, $750 after two years, $1,000 after three years, $1,250 after four years, $1,500 (maximum) after five years. Upon the lives of employees who die leaving no dependents, the amount insurance is $150 for funeral expenses.

The insurance ceases as to any employee with the termination of his employment, but the insuring company, the Metropolitan Life Insurance Company, agrees that insurance on a standard policy form at regular rates may be secured without physical examination upon application to it by the person whose employment is terminated.

PUBLICITY should be built from the viewpoint of the newspapers to which it goes rather than of the corporation from which it comes. Publicity that is not based on public interest is not worth getting; on the other hand, the publicity that really grips the public's attention because it interests them is beyond price. The publicity man, when he has something to release, should, so to speak, get up from his desk, walk out of the building, shake all atmosphere of his job out of his system and then come back in the attitude of a keen-nosed reporter looking for news. Then he can sit down and write his story with the proper perspective.—*James I. Clarke*, manager service department, National Bank of Commerce, New York.

INDUSTRIAL CONFERENCE PLAN TO SETTLE LABOR DISPUTES

President's Conferees Suggest a National Industrial Tribunal with Regional Boards of Adjustment—Position of Public Utility Employees

A tentative plan for the establishment of a national industrial tribunal has been issued by the Industrial Conference appointed by President Wilson. It provides for a tribunal of nine members, to be appointed by the President, representing equally the public, employees and employers. This tribunal would act as a board of appeal from twelve regional boards of inquiry and adjustment, which would try to settle disputes before production is stopped. Further time is asked by the conference before a solution of railroad and other public utility differences can be proposed, though this part of the question is discussed at length in the report. The conference will reassemble on Jan. 12 to consider criticisms of its plan.

In introducing the details of its plan the conference says in part:

"The right relationship between employer and employee in large industries can only be promoted by the deliberate organization of that relationship. . . . New machinery of democratic representation may be erected to suit the conditions of present industry and restore a measure of personal contact and a sense of responsibility between employer and employee.

"Human fellowship in industry may be either an empty phrase or a living fact. There is no magic formula. It can be a fact only if there is continuous and sincere effort for mutual understanding and an unfailing recognition that there is a community of interest between employer and employee.

Retarding Conflicts

"Pending the growth of better relationships between employers and employees, the practical approach to the problem is to devise a method of preventing or retarding conflicts by providing machinery for the adjustment of differences. The conference believes that it is possible to set up a more effective series of tribunals for the adjustment of disputes than at present exists. To be successful such tribunals must be so organized as to operate promptly as well as impartially.

"There must be full participation by employers and employees. There must be representation of the public to safeguard the public interest. The machinery should not be used to promote unfairly the interests of organizations, either of labor or of capital. The plain fact is that the public has long been uneasy about the power of great employers; it is becoming uneasy about the power of great labor organizations. The community must be assured against domination by either. On the other hand, there must be equal assurance that such machinery will not be used to discriminate against organizations of employees or of employers.

"The plan does not propose to do away with the ultimate right to strike, to discharge, or to maintain the closed or the open shop.

"The plan is national in scope and operation, yet it is decentralized. It is different from anything in operation elsewhere. It is based upon American experience and is designed to meet American conditions."

Provision is made for a National Industrial Tribunal and for industrial regional boards. Panels of employers and employees are to be created and Regional Boards of Adjustment formed to act when disputes arise. If either side to the dispute fails to select a representative a regional board of inquiry shall be formed. During the progress of the inquiry such a board may become a board of adjustment if both sides agree to submit the dispute for adjustment. When a board of adjustment fails to reach a unanimous determination it may by unanimous vote elect an umpire whose decision shall have the same effect as that of a board of adjustment. An agreement by the parties to a dispute or a determination by a regional board of adjustment, an umpire or the National Industrial Tribunal shall have the effect of a trade agreement, which parties to the dispute are bound to carry out.

Application to Utilities

A statement as to public utility industries is included and is as follows:

"The plan here proposed presents greater difficulties in application to certain public utilities than to competitive industry. The continuous operation of public utilities is vital to public welfare. As the capital invested is employed in public use, so is the labor engaged in public service, and the withdrawal of either, with the result of suspending service, makes the people the real victim. While continuous operation of all utilities is conducive to the general convenience of the people, that of some of them is essential to their very existence. Of the latter class the railways are a conspicuous example and bear the same relation to the body politic as do the arteries to the human body. Suspension produces practical social and economic anarchy and may impose hardship even to the point of starvation upon large sections of the community. The interruption in such essential public utilities is intolerable.

"The conference believes that a plan of tribunals or boards of adjustment and inquiry should be applied to public utilities, but in the adaptation of the plan two problems present themselves: First, governmental regulation of public utilities is now usually confined to rates and services. The conference considers that there must be some merging of responsibility for regulation of rates and services and the settlement of wages and conditions of labor. Such coördination would give greater security to the public, to employee and employer. Second is the problem whether some method can be arrived at that will avert all danger of interruption to service. These matters require further consideration before concrete proposals are put forward."

"The requirement of unanimity of agreement," says the conference, "has by experience in the United States proved remarkably successful and should assure such confidence that neither side can rightfully refuse to submit to adjustment. A precedent condition of such submission is that the interruption of production shall be delayed. The frank meeting of the parties in controversy together with other men skilled in questions at issue always gives promise of settlement."

The conference also made a statement as to government employees. On this subject it says in part:

"The right of government employees to associate for mutual protection, the advancement of their interests, or the presentation of grievances cannot be denied, but no such employees who are connected with the administration of justice or the maintenance of public safety

or public order should be permitted to join or retain membership in any organization which authorizes the use of the strike or which is affiliated with any organization which authorizes the strike.

"The conference is not now expressing an opinion upon the propriety of the affiliation of other classes of government employees with organizations which authorize the use of the strike."

INQUIRY INTO GUARANTEES AGAINST DECLINE IN PRICES

Federal Trade Commission, Receiving Complaints on This Practice, Sends Requests for Opinions and Will Hold a Hearing Later

The Federal Trade Commission has sent out several thousand letters asking for opinions in regard to the guarantee-against-price-decline system. Complaints have been made to the commission that this system tends to prevent decrease in the cost of living.

A hearing will be held, probably about the middle of March. The commission's letter says: "To the end that every party at interest may be fully represented, the commission is inviting, generally, producers, manufacturers, merchants (wholesale and retail) and consumers to declare their interest, so that the commission may know what parties should be represented."

PROTEST AGAINST NEW RULES FOR EXTENSIONS

Potomac Electric Power Company of Washington Tells Public Utilities Commission Its Policy In Reaching New Business

Representatives of the Potomac Electric Power Company appeared before the Public Utilities Commission, of Washington, D. C., in protest against a proposed set of rules governing the amounts to be paid by consumers of electricity for extensions.

J. S. Barbour, counsel for the Potomac company, told the commission that the rules would require the company to make untold expenditures in extending service to new homes, without a sufficient guarantee that such customers wonld use enough current to allow the company a fair return on its investment in making the extensions.

The present policy of the company is to make free extensions where it is satisfied the amount of energy to be used will justify the amount invested in the extension.

FOREIGN TRADE COUNCIL IS TO HOLD CONVENTION

Seventh Annual Conference of this National Organization to be Held in San Francisco on May 12 to 15 and Electrical Industry is Invited

Men of the electrical industry are invited to give thought to the opportunity to acquire trade information offered by the Seventh National Foreign Trade Convention, which will be held in San Francisco, May 12 to 15, 1920.

Announcement is made that at the coming convention special trade advisors will be present from the Far East, Australasia and South America, to be consulted by American business men. In conjunction with the convention, there will be special foreign trade exhibits held under the auspices of the Los Angeles and Seattle Chambers of Commerce in these two Coast cities.

"The bringing of special trade representatives from the foreign nations to this country so that they may be consulted by American business men, is something that should appeal to every manufacturer or merchant and trade organization in the United States," says Secretary O. K. Davis, in commenting upon this feature of the program. "For the purpose of meeting these foreign trade advisors as well as the large number of Americans who are now doing business in foreign countries, who have been invited to attend, the National Foreign Trade Council is taking steps to have the San Francisco Convention one of the largest ever held in this country."

The National Foreign Trade Council, under whose auspices the coming convention will be held, is made up of leaders of American business engaged in foreign trade. The council is headed by James A. Farrell, president, United States Steel Corporation. Among the other active members may be named: A. C. Bedford, chairman of board, Standard Oil Company of New Jersey; Robert Dollar, president, the Robert Dollar Company, San Francisco; Alba B. Johnson, former president of Baldwin Locomotive Works, Philadelphia; Cyrus H. McCormick, president, International Harvester Company, Chicago; William Cooper Proctor, Proctor & Gamble Company, Cincinnati; W. L. Saunders, chairman of board, Ingersoll-Rand Company, New York; John N. Willys, president, Willys-Overland Company, Toledo, Ohio, and Thomas E. Wilson, president, Wilson & Company, Chicago.

OIL AS FUEL DISCUSSED IN PHILADELPHIA MEETING

H. P. Liversidge Points out in Discussion of Papers That Load Factor of 50 Per Cent is Probably the Economical Dividing Line

A joint meeting of the Eastern Pennsylvania Chapter, American Heating and Ventilating Engineers and the Philadelphia Section, American Society of Mechanical Engineers was held in Philadelphia on Dec. 11, 1919, at which the subject "Oil as a Fuel" was discussed from different viewpoints.

Henry Thomas, combustion engineer of the Sun Company, Philadelphia, presented a paper from the producer's point of view, and E. H. Peabody, of the Babcock & Wilcox Company, of New York, from that of the consumer. A brief statement of the origin of petroleum was followed by statistics on the production of oil, its calorific content and its advantages as a fuel.

Mr. Peabody explained the principal methods employed in oil burning in furnaces and emphasized the economic balance between coal and oil, together with the factors which usually govern the use of coal in contrast to oil for power generation purposes.

In the discussion following the papers, the item of load factor of power plants was added to those mentioned in the papers as affecting the use of oil as a fuel. H. P. Liversidge of the Philadelphia Electric Company stated that a load factor of 50 per cent was probably the dividing line, above which coal is more economical and below which oil would show an advantage under the assumption that prices for oil and coal are comparable.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

A. I. E. E., Utah Section.—Markham Cheever is the new chairman, and Thomas A. Purton the new secretary, of this section.

Oklahoma Utilities Association.—The annual meeting and convention of the Association is to be held in Oklahoma City from Feb. 10 to 13.

Association of Municipal Electrical Utilities of Ontario.—The next semi-annual convention of this association is to be held in Toronto, Canada, on Jan. 15 and 16.

American Electrochemical Society, New York Section.—The section has elected these new officers: W. S. Landis, chairman; W. A. Cowan, vice-chairman; and H. B. Coho, secretary-treasurer.

Electric Club of Chicago.—At a recent meeting of the club Colonel Bion J. Arnold told some phases of his work as a member of the Naval Consulting Board and as an officer of the aircraft production bureau of the army.

I. E. S., Philadelphia Section.—M. Luckiesh, Nela Research Laboratories, Cleveland, Ohio, will deliver an illustrated address on "School Lighting" at the Jan. 16 meeting of this section of the Illuminating Engineering Society.

Kansas State Association of Electrical Contractors and Dealers.—The next semi-annual meeting of the Association will be held in Topeka on April 12 and 13. William L. Goodwin and Samuel Adams Chase are scheduled to be among the speakers.

A. I. E. E., Lynn Section.—Dr. Saul Dushman, Research Department of the General Electric Company, Schenectady, N. Y., spoke on "Structure of the Atom" at the Nov. 5 meeting of the Lynn (Mass.) section of the American Institute of Electrical Engineers.

A. I. E. E., Philadelphia Section.—N. E. Funk spoke on the Chester generating station of the Philadelphia Electric Company and W. F. James reported on the development committee's work at the Nov. 10 meeting held by this section of the American Institute of Electrical Engineers.

A. I. E. E., San Francisco Section.—Under the auspices of this section of the American Institute of Electrical Engineers, Lieut. Colonel F. B. Jewett, chief engineer of the Western Electric Company, delivered an illustrated address on the subject of "Electrical Communication in War Time" in San Francisco on Nov. 24.

A. S. M. E., Connecticut Section.—Harold P. Donle, radio engineer of the Connecticut Telephone & Telegraph Company, lectured on "The Application of the Vacuum Tube to Radio Telegraphy" before the Nov. 21 meeting of the Meriden Branch of the Connecticut Section, American Society of Mechanical Engineers.

High Tension Club.—At the Nov. 18 meeting of the Club held in Keokuk, Iowa, these officers were elected: J. L. S. Scadding, president; G. N. Carlson of the Keokuk Electric Company, first vice-president; P. I. Robinson of the Fort Madison Electric Company, second vice-president; Albion Davis of the Mississippi River Power Company, secretary, and B. H. Moore, treasurer.

District of Columbia Electrical Contractor-Dealer Association. — W. L. Goodwin delivered an address on "Scientific Electrical Merchandising and Electrical Development," Samuel Adams Chase spoke on "Live and Help Live," and C. A. Payne gave a talk on "Patent Rights as Applied to Heating Elements" at a banquet held by the Association in Washington on Nov. 21.

Ontario Association of Electrical Contractors and Dealers.—Among the speakers at the Association's No. 24 meeting were J. M. Wakeman, general manager of the Society for Electrical Development; H. H. Couzens, general manager of the Toronto Hydro-Electric System; C. H. Wilson of the Apex Electric Appliance Company; Kenneth McIntyre, secretary of the association; and George J. Beattie.

Portland Sections of N. E. L. A. & A. I. E. E. Meet Jointly.—On Nov. 18 the Portland sections of the National Electric Light Association and the American Institute of Electrical Engineers held a joint meeting at which Dr. F. B. Jewett, chief engineer of the Western Electric Company, delivered an address entitled "The Development of Communication of Intelligence During the War."

American Institute of Electrical Engineers.—A meeting of the Institute will be held in Chicago on Jan. 9 under the auspices of the lighting and illumination committee. The following papers will be presented: "Series Systems of Distribution for Street Lighting" by W. P. Hurley, "Multiple Systems of Distribution for Street Lighting" by Ward Harrison, and "Mixed Systems of Distribution for Street Lighting" by Charles P. Steinmetz.

American Electrochemical Society.—On April 9, the second day of the spring meeting of the society which is to take place in Boston, Mass., from April 8 to 10, a joint meeting will be held with the American Institute of Electrical Engineers and two symposiums will be presented. One will be on "Electrically Produced Alloys" and the other on "Power for Electrochemical Purposes." Several papers on "Electric Furnaces" and "Electroplating" are being planned for presentation on the first and third days of the meeting.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Electric Franchises in New York City.—A study on this subject, by Leonora Arent, professor of economics in Saint Mary-of-the-Woods College, is published by Columbia University as one of the "Studies in History, Economics and Public Law," edited by the faculty of political science. To ascertain the status of the franchises held by the companies is the purpose of the study. Attention is also devoted to the subjects of franchise by acquiescence and of the duration of grants in which no time limit is expressed.

International Trade Conference.—The foundation of an international organization of business men was laid at the recent Atlantic City meeting of the International Trade Conference. Four commercial missions, one each from Great Britain, France, Italy and Belgium, joined with representatives of the Chamber of Commerce of the United States in planning the organization. A name for the new international association will be chosen later, after a committee representing the several countries concerned has worked out details of organization.

Louisville Company Starts Customer-Ownership Plan.—The customer-ownership plan of distributing electric and gas securities among the citizens served by Byllesby companies has been extended to the Louisville Gas & Electric Company of Kentucky. Within a few days after the announcement of the plan in the newspapers 520 inquiries had been received and nearly 100 residents had become preferred shareholders. The company has opened a new investment department in charge of J. W. Smiley, formerly with the securities department of the Northern States Power Company.

Good Light Reduces Traffic Accidents in Cleveland.—Between 5 p.m. and 9 p.m. there were 25 per cent more traffic accidents in Cleveland during the winter months than in the summer months. This was attributed to poor light and not to slippery streets by Ward Harrison at the thirteenth annual convention of the Illuminating Engineering Society's Convention in Chicago. In support of this claim it was stated that from 9 a.m. to 5 p.m. the number of accidents was higher in the summer months than in the winter months by about 10 per cent. The records also showed that in the best lighted sections of the city all the winter accidents only exceeded the summer figures by 5 per cent.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Coal Clause Upheld.—A complaint alleging the unreasonableness and illegality of a coal clause in the rate schedule of the Penn Central Light & Power Company, brought by the Pennsylvania Glass Sand Company, was dismissed by the Pennsylvania Public Service Commission. The commission stated that under the coal clause the "burden of proof with respect to the reasonableness of the increased rate rested upon complainant, notwithstanding which the respondent offered considerable testimony on this score which was not controverted. . . . The evidence does not disclose that the imposed rate was unjust or unreasonable in amount, and therefore the complaint must be dismissed."

Service Concerns Consumers Primarily.—After a hearing the Illinois Public Utilities Commission has decided a case affecting the Dahlgren Electric Light Company. As between twenty citizens and taxpayers of a village who objected to a compromise agreement between the village board and an electric utility respecting hours of service, declaring such agreement to be unreasonable, and thirty-three taxpayers and consumers of electric current supporting such an agreement, it appeared to the commission that the matter of hours of service would concern primarily the consumers of electric service and that the village board as representatives of the village would, to a great extent, voice the sentiments of the people with respect to such hours of service.

Robbing Peter to Pay Paul.—In authorizing increased street railway fares for the Washington Railway & Electric Company the District of Columbia Public Utilities Commission answered a suggestion that the need for more revenue be met by higher electric rates. It showed the inequity of burdening one service to meet the cost of another. "To equalize the existing disparity in the net earnings of the two principal street railway systems, it has been suggested," says the commission, "that the increased revenues needed by the Washington Railway & Electric Company be provided by increasing the existing rates for electric light and power, thus throwing upon the electric light and power consumers the burden of making good the deficit on street railway operation. This the commission believes to be not only inequitable and unjust, but illegal. In the opinion of the commission, if the problem before it were solved in this manner, an order based thereon could be successfully attacked in the courts by any user of electric light or power. The real question is this: Shall the full cost of furnishing street railway service be paid by the users of that service, or shall a part of it be paid by the users of a totally dissimilar service through increased rates to them, because the owners of the two utilities in question happen to be identical?"

Extensions for Service.—In ordering the Utah Power & Light Company to extend its electric service to the village of Ririe the Idaho Public Utilities Commission said in part: "A utility operating under a certificate of convenience and necessity in a given district does not fulfil its full duty when it merely extends to and absorbs business which has developed to a point which will at once return a satisfactory profit. A utility owes its share of effort to the creation and development of new business. Expenditures made under the order and direction of the commission are of a nature which the commission is bound to observe as being entitled to a fair return, and the adjustment of the rates and classes of service by the commission in the future will be made with this element in view. The former policy of public utilities in anticipating future demands for service by extending and improving their lines to meet such service when it should have developed is no longer either needed or desired. Under the commission's control the necessity for entering and holding territory by occupation is done away with, but this means that a utility will be required to reasonably meet and anticipate a developing demand, and to facilitate its further increase by reasonable extension. Where a public utility has a district apportioned to it under a certificate of public convenience and necessity, the determinative test is not whether a given extension will of itself pay a profitable income, but whether the business in that district, or districts, as a whole, including the contemplated extension pays a sufficient return. The defendant operates as a unit, and serves a wide field of patrons. These services naturally do not all show the same percentage of profit, and this is not required. The commission may order extensions at any time, if necessary, to meet public convenience or necessity, where the return to be expected is reasonably sufficient when the utility's business is considered as a whole, even though the contemplated extension may not, of itself and standing alone, furnish a profitable income. We have no doubt that, in the absence of the commission, a village offering in the neighborhood of $6,000 annual revenue, and which showed a development resulting in a doubling of its electrical demand within a period of twenty months, would be promptly entered by some utility which would desire to have and hold the business which such a community may be reasonably said to offer, both present and future."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

The Word "Employer," in Workmen's Compensation Act.—Claim for injuries received by patrolman of New York City while removing a bulb from an electric fixture in ceiling of police station, work detailed to him by his superior officer, comes within Workmen's Compensation Law, the term "employer" including a municipal corporation, and the term "employee" meaning a person engaged in one of the occupations enumerated in section. (178, N. Y. S., 402.)

Low Uninsulated Wire Over Pathway.—Petition alleging that uninsulated wire was part of a company's line, that immediately beneath it was a pathway used by public, as known to defendant city, or which might have been known by exercise of ordinary care, and which was known to an employee of city, that wire had been uninsulated for several years and was caused to fall within four or five feet of ground by city's blasting, which condition was brought to attention of employee in charge, and defendant's husband was killed by contact with that wire, stated a cause of action against city for negligent homicide. (Higginbotham v. City of Rome, 100 S. E., 720.)

Newly Discovered Cumulative Evidence.—Evidence adduced by affidavits, on a motion for a new trial, in an action against a corporation, for damages for wrongful death alleged to have been occasioned by its negligent use of electricity, as having been first discovered after a trial resulting in a verdict for the defendant, and tending to prove the breaking of one of its high voltage wires, as to which no evidence had been adduced on the trial, and resultant contact of such wire with its service wires, at such a place and in such manner as would have caused the high voltage of the broken wire to enter the building in which the decedent came to his death by means of an electric shock, at or about the time of his death, is not cumulative. Under the operation of the rule *res ipsa loquitur*, the introduction of such evidence would make the defendant company in such case liable, if the break in the wire was the proximate cause of the injury, in the absence of proof by it of proper construction of the wires at the place of the break and due inspection of its lines, wherefore it is of such character as ought to produce a different result upon a new trial, if its effect should not be avoided in some way. (Lindawood versus Potomac Light & Power Company, 100 S E 868.)

J. S. Haas, who has just recently been released from service, has been appointed electrical engineer for the Atlantic City (N. J.) Electric Company's power plant.

Earl S. Hiscox has been appointed superintendent of the Jewett City (Ct.) municipal electric lighting plant, succeeding Edward Rousseau, who has resigned to go into the electrical supply business.

Louis L. Blake has been appointed manager of the Peabody (Kan.) Light, Power & Ice Company. For the past ten years Mr. Blake was superintendent of the Ashland (Ohio Gas & Electric Light Company.

L. H. Newbert, manager of the commercial department of the Pacific Gas & Electric Company, with headquarters in San Francisco, has been appointed by President Ballard of the National Electric Light Association, to head the committee on cooperation for the association during the coming year's activities. Mr. Newbert began his business career with the Pacific Gas & Electric Company, back in 1900, where in the district around Marysville, he proved of unusual ability in making power sales and lighting load sales for his company. Later he was transferred to the San Francisco office, where as head of the sales department of the company, he built up an organization of unusual strength throughout the central district of California. Later the commercial department and the sales department were combined into one

LEE H. NEWBERT

department, to be known as the commercial department, and Mr. Newbert was appointed to head this important position, which he has held during the past three years. Since the inception of the California Electrical Cooperative Campaign, Mr. Newbert has been chairman of the advisory committee. Unquestionably a large part of the activities of this committee appointed by Mr. Ballard, will concern itself with recommending the activities of the California Electrical Cooperative Campaign in its application to national problems.

Men of the Industry

Changes in Personnel and Position— Biographical Notes

Howard M. Turner, who has been engaged in private practice since his discharge from the U. S. Engineers, has opened a consulting office at 70 State Street, Boston, Massachusetts. Before his entrance into the service Mr. Turner was assistant to the president, and hydraulic engineer, of the Turners Falls (Mass.) Power & Electric Company.

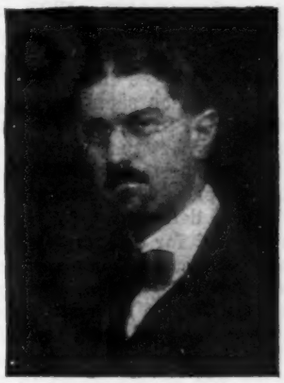
Paul Bailey has been transferred by the American Gas & Electric Company from the Atlantic City Electric Company where he has been electrical engineer for the past two years, to the Ohio Power Company, with headquarters at Fremont.

Edward J. Donnelly, formerly of the Tuxedo Electric Light Company and Southern Dutchess Gas & Electric Company of Beacon, N. Y., has been appointed electric commercial agent for the Queens Borough Gas & Electric Company, Far Rockaway, N. Y.

Daniel C. Jackling, president of the Utah Power & Light Company, Salt Lake City, Utah., and managing director of vast copper mining interests has been awarded the Distinguished Service Medal in recognition of his accomplishments when in charge of the government explosive plants built during the war.

H. J. Littlefield, who has been connected with the Queens Borough Gas & Electric Company, Far Rockaway, for the past thirteen years, more recently as Electric Commercial Agent, has left that organization to organize the United Electric Equipment Company of Rockville Centre, to carry on an electrical merchandising business in the Borough of Queens and the section of Long Island to the East.

Alexander Macomber, who recently became associated with George P. Carver and John West in the new engineering firm of Carver, Macomber & West, Boston, is well known in the central station field. He was graduated from the Massachusetts Institute of Technology in 1907 in the electrical engineering course and for two years was engaged in hydroelectric construction work in northern California, later being employed by D. C. & W. B. Jackson. In 1910 he joined the interests now known as Charles H. Tenney & Company, Boston, as electrical engineer, becoming assistant engineering manager in 1917. During this period he was engaged in varied work associated with upbuilding and operation of the public utilities managed by the Tenney organization, including design, construction, rate, valuation and commission work. The properties under Tenney management grew in number from four to about twenty-five in this time. In May, 1917, Mr. Macomber went to Plattsburg, N. Y., to attend the First Officers' Training Camp, and was soon commissioned captain in the Engineer Corps, being assigned to the development of searchlight problems in connection with mobile warfare. He was promoted to major while on this duty and organized the 56th U. S. Engineers, which was the searchlight regiment of the A. E. F. Major Macomber returned to the United States in



ALEXANDER MACOMBER

May, 1918, and resigned his commission. He is a member of the American Institute of Electrical Engineers, of the Engineers Club of Boston, and of the Alumni Council of the Massachusetts Institute of Technology.

Obituary

Richard B. Snyder, sales manager of the Milwaukee (Wis.) Electric Railway & Light Company, died on the morning of Nov. 14 from valvular heart trouble after a severe illness of about five months. Mr. Snyder was born in Baltimore about 40 years ago and went to the Milwaukee Company in 1912.

George B. Diem, superintendent of construction of the Windsor plant of the American Gas & Electric Co., died on Oct. 26. Mr. Diem was born in Switzerland in 1875 and there received his early education. After spending several years with large engineering firms of Europe, he came to this country in 1907 and shortly afterwards became associated with Sargent & Lundy. After spending three years with this concern in its Chicago office, he went to Des Moines, Iowa, as resident engineer for the company, in charge of the erection of a large power plant. He also held the position as resident engineer for this company in Omaha, Kansas City, and Waco, Tex. Upon completion of the work at Waco he became superintendent of construction at the Windsor plant where he remained for the past four years.

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

ELECTRICAL SHEET MILLS BOOKED TO JUNE, 1920

Demand for All Grades of Sheets Is Heavy at Prices Prevailing Since Last March and Many Electrical Manufacturers Will be Short of Stocks

Producers of electrical sheets are sold well through the second quarter of 1920. With one exception the old price of last March prevails, and the amount of this one advance is $6 per ton. During the summer and early fall producers were booking for the end of 1919 and first quarter of 1920, at the price which should then prevail. At that time the steel strike was in the offing with an unknown result. Now it is generally felt that it will not be necessary to exact a premium on sheets because of a higher wage scale, and the former price is in general prevailing as late as first half of 1920 delivery.

The demand for electrical sheets is very heavy, and it is evident that electrical manufacturers throughout the country have full order books. Demands have been received for well over available productive capacity, and consequently some electrical machinery manufacturers are going to go short on sheets. Some prominent producers of electrical apparatus are known to be in the market for additional electrical sheets. There is no reason to believe that these companies did not order sufficient material but rather that allotments to them were not sufficient to cover their excess needs along with the excess needs of virtually all manufacturers using electrical sheets. Sheet production has been higher than normal capacity in certain mills recently, and it is expected that in 1920 more capacity will be added.

This short market is going to work hardship on many manufacturers who failed to take advantage of open books to order according to requirements for the first half of the new year. It is expected that some old customers are going to suffer in this connection as well as new customers. As present unfilled steel orders are greater than at any time this year, the prospect is not too bright for anything but over-capacity orders for 1920.

ELECTRICAL EXPORTS DURING OCTOBER TOTAL $7,280,663

Gain of Over a Million Dollars in Excess of September's Exports Brings Total for Ten Months to $75,719,867

October's electrical exports amounted to $7,280,663, over a million-dollar gain on those of September. The last two months have pulled down the average for the year to date to $7,571,987 per month, so that the total for the year on this basis would be $91,000,000. This, however, would be a 50 per cent increase over the total for 1918, the highest previous year.

Notable gains over September were in exports of carbons, fans, heating and cooking ware, insulated wire, motors, rheostats, telephone material and transformers. This gain over September is encouraging in the face of shipping troubles along the Atlantic Coast during October. Only during one month of this year were exports of heating and cooking ware higher, and the same is true for telephone materials. Exports of motors and rheostats were higher in only two months.

Total exports for the ten months of 1919 amounted to $75,719,867, a gain over the same period of 1918 of 64 per cent. In only the item of carbons was any loss noted, and that exceedingly slight. Several items showed over 100 per cent improvement.

Figures in the accompanying table were compiled by the Bureau of Foreign and Domestic Commerce:

	October		Ten Months Ended October	
	1918	1919	1918	1919
Batteries	276,730	507,704	2,594,954	5,114,513
Carbons	114,991	121,621	1,250,382	1,228,848
Dynamos or generators	254,156	452,946	2,719,085	4,598,879
Fans	15,679	79,406	723,342	1,320,214
Heating and cooking apparatus	86,144	164,114	556,928	1,351,410
Insulated wire and cables	525,031	487,444	4,740,285	7,780,151
Interior wiring supplies, including fixtures	83,656	168,902	1,175,035	1,899,424
Arc lamps	273	2,239	13,737	13,901
Carbon-filament lamps	5,758	6,075	74,218	144,411
Metal filament lamps	191,344	334,835	2,715,756	4,109,046
Magnetos, spark plugs, etc	222,099	222,972	2,170,904	2,564,409
Meters and measuring instruments	83,674	237,077	1,545,994	2,506,697
Motors	1,147,159	1,007,930	6,636,810	8,853,573
Rheostats and controllers	30,281	63,153	197,859	438,269
Switches and accessories	124,720	347,152	1,836,686	3,118,811
Telegraph apparatus, including wireless	19,689	44,566	258,949	751,973
Telephones	148,312	388,428	2,377,119	3,079,565
Transformers	206,575	218,789	2,779,377	3,332,601
All others	1,324,313	2,425,310	14,250,880	23,513,172
Total	4,860,584	7,280,663	48,618,300	75,719,867

GENERAL ELECTRIC COMPANY EXPANDING IN SUPPLY FIELD

Company Has Leased Several Existing Concerns with Excess Capacity To Care for Demands which Are Growing at Rate of $10,000,000

In order to keep pace with the growth in the electrical industry, without in all cases consuming the time required to construct new plants and train new organizations, the General Electric Company has in several instances taken advantage of opportunities to acquire under lease existing supply concerns with excess capacity, with options to purchase at some later date. The company's financial statements of the last ten years show that its sales have grown at the rate of $10,000,000 a year at least. Therefore, if the company is to fulfill the ordinary demands of its customers, factory facilities to provide for such increase must be procured on practically an annual schedule.

In reply to questions asked recently by a representative of the ELECTRICAL WORLD, one of the officials of the General Electric Company said: "The General Electric Company, like all progressive electrical manufacturers, will continue to expand. That is natural and inevitable. Besides, balancing out certain large plants and increasing others, it will probably establish unincorporated units in new locations. In certain cases, however, particularly in the supply field, considerable time will be saved, when our customers are making unusual demands on us, if we can purchase outright or negotiate, at least, for some going business of good reputation and with surplus capacity. Such arrangements may also include the right to purchase the plant at the end of five years or longer. In this way will we be in a position to give service to our customers quickly, without waiting to train an organization and establish volume and economical production.

"That is all there is to the recent acquisitions by the company. They do not, in the amounts involved, constitute a

very large proportion of our average annual outlays for new facilities."

In accordance with these plans the company is now negotiating a lease with the D. & W. Fuse Company of Providence, R. I., with provisions for purchase at the end of ten years. The last concern the company leased was that of the rigid conduit business of the American Conduit Manufacturing Company. A few months prior to that the business of the Trumbull Electric Manufacturing Company was taken over under contract.

PRODUCTION OF ELECTRICAL GOODS MUST BE INCREASED

Spring Requirements Will Not Be Met Unless Manufacturers Do Something to Increase Output

With the steadily growing demand for electrical goods, with rapidly lengthening deliveries and stocks on hand getting lower, it becomes more and more apparent that production must be increased, and that quickly, if the spring requirements for electrical goods are to be met quickly and fully. The winter season is generally the low point in the demand for electrical materials of most kinds. To be sure, those electrical equipments that require a long time for fabrication must be ordered during the winter months in order to secure delivery when the project is ready for installation. Generally speaking, however, electrical manufacturers have an opportunity during the winter months to fill out their stock and place themselves in a favorable position to meet the demands opened up by spring building.

Everything next year points to increased requirements for electrical goods. It is evident, however, that unless deliveries turn from a condition of getting worse to one of getting better these requirements will not be met.

Probably the most serious drawback to the production is labor. Labor is requiring shorter hours and on top of it, as a result of its high wages, is losing considerable time. One of the largest electrical manufacturing plants in New England, employing about 10,000 people, reports that about 1,500 are absent every Saturday and that not more than 300 of them have a legitimate excuse. The managers of this plant state that it is the high wages that are causing the men to work only part time.

GOVERNMENT PLAN TO SELL SURPLUS WIRE AND CABLE

Bids for 1,710,000 Feet of Telephone Cable and 854,923 Pounds of Copper Wire Will Be Received Until January 13

The Director of Sales, War Department, following a conference on Dec. 16 with representatives of wire and cable manufacturers, dealers and distributors, announces plans for disposing of the present available supply of copper and wire cable now held as surplus by the War Department. There are approximately 1,710,000 ft. of telephone cable and 854,923 lb. of copper wire to be marketed. Proposals for this supply will be received up until Jan. 13, 1920, at the office of the Director of Sales, Munitions Building, Washington, D. C.

Two plans for disposing of the material were agreed upon as a result of the conference. These were: first, to request proposals for sale outright, the customer to be permitted to submit proposals for all or any part of the material shown on the list; and, second, to ask for proposals for the sale of all of this material on a commission basis. In the proposals to be submitted under the second plan, the bidders will be required to state the amount of commission to be charged, the method of determining minimum prices at which the sale will be made, and to state the minimum prices at which they will purchase the residue of this material at the end of the time specified in the proposal. Furthermore, the Director of Sales will pay particular attention to the ability of prospective contractors or dealers to handle transactions of the magnitude of this sale.

Also the Director of Sales reserves all rights to reject any or all proposals and to continue further negotiations should no satisfactory proposals be received. Under either plan, sales will be made f.o.b. cars, "as is" and "where is."

The greater part of the wire and cable is located in the Philadelphia ordnance district. The remainder is stored at various depots throughout the country. A majority of the material is in excellent condition and packed as originally prepared for overseas shipment.

The approximate quantities and descriptions of the cable and wire are as follows:

1,140,080 ft.	10 pair lead covered telephone cable.
79,200 ft.	10 pair double wrap paper telephone cable.
599,280 ft.	15 pair lead covered telephone cable.
680,800 ft.	25 pair armored, lead telephone cable.
34,320 ft.	25 pair steel armored telephone cable.
100,320 ft.	50 pair lead covered telephone cable.
2,000 ft.	19 g. cable for interior construction.
5,031 lb.	No. 1 triple braid weather proof copper wire.
3,711 lb.	No. 2 triple braid weather proof copper wire.
4,489 lb.	No. 4 triple braid weather proof copper wire.
3,128 lb.	No. 6 triple braid weather proof copper wire.
1,170 lb.	No. 10 triple braid weather proof copper wire.
39 lb.	No. 14 hard drawn tinned copper wire.
26,369,000 ft.	No. 17 twisted pair copper wire.
1,016 lb.	No. 2 rubber covered double braid copper wire.
4,116 lb.	No. 6 rubber covered double braid copper wire.
8,930 lb.	No. 6 rubber covered single braid copper wire.
9,410 lb.	outpost strand, single copper wire.
1,235,695 ft.	bare outpost strand.
35,421 lb.	bronze, tinned .014 in.
87,363 lb.	bronze, tinned .013 in.
6,942 lb.	⅜-in. annealed rods.

PRODUCTION OF ELECTRICAL MACHINERY IS FAR BEHIND

A Few Small Broken Stocks Are Available, but Shipping Dates Are Advanced from One Month to More than a Year

Probably the most important feature of the electrical apparatus marketed today is shipments. While for some types of apparatus shipments are virtually normal, for other types, motors particularly, shipping dates have lengthened tremendously. Shortage in some lines of raw materials has something to do with this condition, but demand is the real factor.

Fractional-horsepower motors a year or so ago could be shipped from stock or at the worst in twelve weeks. Now it is rather common to hear of a manufacturer's production booked up until after January, 1921, more than twelve months. The heaviest demand seems to be for ¼-hp. and ⅜-hp. appliance motors, and on these sizes more than 100 weeks has been given as a shipping date. On the other hand, certain manufacturers could begin deliveries of a portion of an order in twenty to thirty weeks.

Broken stocks exist for motors from 1 hp. to 50 hp. A few of virtually any size in this range can be picked up in some city, but in general it requires from eight weeks to six months to fill a fair-sized order. Normally stocks would be spotty, but shipments would be nearer eight to twelve weeks. For larger motors the volume of orders is not so great, and they can be completed in about the same time, that is eight to twenty-four weeks. Normal shipments would be up to fourteen weeks.

Generators, rotaries and kindred machinery are not coming through in such volume as to lengthen appreciably their ordinary shipping dates. The lowest limit given is twelve weeks, and for larger and more special machines the time of filling an order goes up to ten months.

The exceptionally heavy demand for distribution-type transformers has depleted local and factory stocks to a great extent. These stocks are badly broken but can be transferred to meet a hurry order. It is requiring from six to ten weeks to fill an order which ordinarily would be filled from stock.

Apparatus transformers are up against a stiffer shipping schedule, from six to ten months. The policy of central stations with regard to high-tension customers purchasing

their own transformers has resulted in a more diversified distribution of orders among transformer manufacturers. The increasing number of special engineering features which must be worked out to fill these various orders is taxing to a great extent the engineering capacities of the manufacturers and is lengthening shipping dates. Formerly shipments were made in eight to thirteen weeks. At the present time one company is figuring on an equivalent of more than 1,500,000 kw. capacity in special transformers, each one under 200 kw.

House meters used to be carried in stock. Now the demand has taxed manufacturing capacity in spite of recent doubling of that capacity by some producers. A small amount of broken stock exists, but on a large order it takes about three weeks in which to commence shipments. Re-orders are being placed before the original one is completed.

Since summer steam-turbine shipping dates have nearly doubled for one manufacturer. His summer date was rather below normal. However, it is taking from five to seven months to finish turbines in capacities under, say, 1000 kw., and from ten to twelve months for the larger sizes. These dates are little above normal. The absence of capable labor is a contributing factor with one producer. One manufacturer believes his average production is behind about 25 per cent. This would not seem far from a pretty fair estimate of all electrical machinery production.

METAL MARKET SITUATION

Copper Firm After Month of Heavy Sales—Further Advance Brings Lead Price to 7.50 Cents

Copper trading is again active after the Christmas holiday and the market shows a firm tone. Prices rose to 18.75 to 19.00 cents, although some premiums are being offered for future deliveries. Dealers' prices are on a par with those of producers. First quarter deliveries are quoted from 19.25 to 19.75 cents, while second quarter is held at 20.00 to 20.50 cents a pound. Inquiries have been received for second quarter business and already there has been much activity in these long deliveries. The third quarter is receiving attention.

Sales of copper for the month of December have been estimated at nearly 300,000,000 pounds, the biggest month since hostilities ceased. It is also estimated that domestic demand is taking 75 per cent of normal refinery production, whereas in former years it has absorbed from 40 to 60 per cent. Foreign sales, too, have recently increased, particularly to France, Great Britain and Japan.

Lead price was advanced again on Dec. 26 by the American Smelting & Refining Company, this time $7 a ton, bringing the New York price to 7.50 cents a pound. An extreme shortage exists in the market, which the outside interests were taking advantage of with higher prices than 7.50 cents, the most recent report showing payments as high as 8.00 cents.

NEW YORK METAL MARKET PRICES

	Dec. 22	Dec. 30
Copper:	£ s d	£ s d
London, standard spot	104 0 0	16 15 0
	Cents per Pound	Cents per Pound
Prime Lake	19.00	19.00 to 19.50
Electrolytic	18.50	18.75 to 19.00
Casting	18.25	18.50
Wire base	21.50 to 12.00	21.50 to 22.00
Lead, trust price	7.15	7.50
Antimony	9.62½	9.62½
Nickel, ingot	41.00 to 42.00	41.00 to 42.00
Sheet zinc, f.o.b. smelter	11.50	11.50
Spelter, spoy	8.65 to 8.75	9.00 to 9.10
Tin, Chinese *	55.50	59.50
Aluminum, 98 to 99 per cent	32.00 to 33.00	32.00 to 33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	17.00 to 17.50	17.00 to 17.50
Brass, heavy	9.50 to 10.00	9.75 to 10.25
Brass, light	7.75 to 8.00	7.75 to 8.00
Lead, heavy	5.87½ to 6.12½	6.00 to 6.25
Zinc, old scrap	5.00 to 5.25	4.75 to 5.00

THE WEEK
IN TRADE

THE new year opens with the shelves almost bare of electrical goods. Deliveries are long and demand is high. High as it is, however, it is small compared with the call that is expected to come during the second quarter.

Prices are slowly mounting. Advances are reported this week in fir cross arms, bells and buzzers, safety switches, porcelain, pole line hardware and conduits

Inventories are being taken and at the conclusion thereof long delivery purchases can be expected. The tendency to quote prices as of date of shipment is again coming to the front.

NEW YORK

Sales held up well during Christmas week and jobbers' stocks of appliances are so broken as to be of little account as such. Deliveries are still behind but in some schedule material they are picking up. Complaint was heard from one jobber that manufacturers of this material were beginning to dump too much material on him. The answer is undoubtedly that he has tried to protect himself too heavily, and better shipments from manufacturers are giving him more than he can use at this time.

Good supplies of pipe can be found in some places although in general small sizes are scarce. Wire is in sufficient stock, or on the way, to satisfy needs. Lamp stocks are being replenished in better volume. Heater sales are good and shipments are coming through well to keep stocks in fair condition.

Prices have advanced on fir cross-arms, wood and iron box bells and buzzers and on the safety switches of at least one manufacturer.

BELLS AND BUZZERS.—One manufacturer on Dec. 20 advanced the price on iron and wood box bells and buzzers about 15 per cent. An advance of 11 per cent was made by another manufacturer about 6 weeks previously. The demand is steady and shipments good.

CROSS-ARMS.—On Dec. 22, prices advanced on fir cross-arms 20 per cent, New York and New Jersey warehouses. Buying is active and shipments good. Yellow pine advances have been announced, but on Dec. 22 their prices were cancelled, subject to later announcement.

WIRE.—There is a transition going on in prices of rubber-covered wire because of rising cotton prices. Bases are averaging 30 cents. The tendency is to raise the net price of small sizes and lower that of large sizes because cotton is a larger factor in the former and copper in the latter. No. 14 prices are $11.75 to $12.00 in 5000 ft lots.

SOCKETS.—In standard packages, discounts of 20 to 23 per cent prevail, while in 1000 lots discounts as high as 27 per cent can be found. Deliveries of key and keyless are good while those of chain sockets are still poor.

FUSES.—Better sales are reported in renewable fuses, following their recent listing as standard by the Underwriters' Laboratories. To date the products, in whole or in part, of four manufacturers have been listed. Deliveries of renewables are not so good as of non-renewables.

CONDUIT.—Rigid conduit prices of $71.15 are prevailing on ½-in. black in 5000 ft. quantities. In general, stocks of small sizes are poor, although in spots they are fair.

FLEXIBLE ARMORED CONDUCTOR.—Production of steel strip is still below normal so output of finished conductor is more limited. No. 14 single strip is selling for $86 to $88 per M and double strip for $88 to $90 in 1000-ft. lots.

LAMPS.—Distributers' stocks are building up in better shape, while sales are heavy.

MOTORS.—Good sales are reported in sizes up to 50 hp. Contractor-dealers are paying more attention to motor stocking and are ordering well for spring delivery.

SAFETY SWITCHES.—Price advances of approximately 10 per cent have been announced by one manufacturer as of Dec. 22.

CHICAGO

The Christmas trade among jobbers and dealers was the greatest in their history, some jobbers stating that they have more than doubled their business of last year. In the line of household devices all stocks with the exception of irons were practically exhausted. Christmas-tree lights sold as never before, one jobber stating that whereas he had formerly carried over 4000 or 5000 sets, this year he had completely sold out his reserve, and also large supplies which he had recently received. Porcelain tubes and knobs are very scarce, and one jobber has put in a price increase of about 15 per cent. Practically no deliveries are being made on non-metallic flexible conduit. Building permits in Chicago for the week amounted to $1,300,000. In St. Louis, Mo., the Block Two-Eighty-One Realty Company will erect within the next year a $1,250,000 annex for the Rice-Stix Dry Goods Company. The St. Louis Home & Housing Association which intends to build 1000 homes by the end of 1920, has started work on 175 houses. The American Range & Foundry Company of Minneapolis, Minn., will soon start work on a large plant in East St. Louis. Work has been started on the $2,000,000 Hotel Wolverine in Detroit, Mich. Waukegan, Ill., will shortly have erected 158 bungalows at a total cost of about $500,000.

WIRE.—Prices for rubber covered and waterproof are stiff with a base of 30 cents. Shipments are improving; some jobbers are receiving large quantities of wire, but they relay it on to dealers and contractors as fast as they get it, and consequently are not building up their stocks.

PORCELAIN KNOBS AND TUBES.—It is almost impossible to get deliveries on porcelain, and some manufacturers have called in their price-lists. One jobber has increased his prices about 15 per cent, but most of them are still holding the old price of about $18 per 1000 for knobs and $6.25 per 1000 for tubes.

HOUSEHOLD APPLIANCES.—Sales of appliances of all kinds have broken the record. Some jobbers state that they have done over twice as much business as they did last Christmas. Practically no goods are left on the shelves except a few irons. This is in spite of the fact that some large shipments were received just before Christmas. In St. Louis jobbers helped out the city dealers by selling them merchandise which was ordered by country dealers, but which came in too late to get into the country for the Christmas trade, and on which cancellations are now expected.

CHRISTMAS TREE LIGHTS.—For the first time in history jobbers sold out practically every light they had in their houses. One jobber states that he had formerly always carried over 4000 or 5000 sets until the next year, but this year besides selling out large quantities which had been shipped in to him, he cleaned up his entire reserve. So great was the demand that department and other stores raised their prices 25 per cent during the week before Christmas.

CONDUIT FITTINGS.—Jobbers have advanced their prices on condulets. Old discounts of 20 per cent on one-fifth standard package, and 30 per cent on standard package lots have been lowered to 5 per cent and 15 per cent respectively.

MOTORS.—Three-phase alternating current motor production is twice that of last year, according to one manufacturer. Deliveries are improving to six to twelve weeks, depending upon the size and type when not in stock, and there are a few of some standard sizes in stock. The greatest demand is for motors from 5 hp. to 25 hp. with some calls up to 75 hp. three-phase, but very little call for larger sizes. Sales of fractional horsepower motors are practically all in ⅓ hp. and ¼ hp. single-phase.

SECOND-HAND EQUIPMENT.—There is a good demand for second-hand power-house equipment such as generators, etc., up to about 500 kw. There is little or no call for larger units. The demand for second-hand alternating-current motors is the same as that for the new machines, the greatest in 5 hp. to 25 hp. and ⅓ hp. to ¼ hp. sizes.

BOSTON

The year 1919 closed with a record-breaking volume of trade in electrical New England, both in quantities and money. Expansion of industrial facilities and the building of new mercantile and residential structures continues at a pace which bids fair to exert heavy pressure upon manufacturers and distributers in 1920. In the first eleven months of 1919 New England building operations totalled $209,000,000, or $28.12 per capita. No such total has ever been attained before in this district. Jobbers' stocks are heavily depleted as regards domestic heating appliances and some classes of wiring material, but are beginning to improve in general volume. Orders are being freely placed with the manufacturers for delivery as late as the coming summer. Collections were not up to normal at the close of December, and vigorous efforts were made early this week to round up delinquents. Prices and deliveries are still much unsettled. Rumored advances in the prices of electrical measuring instruments, portable types, and friction tape are being discussed. Condulets are up about 20 per cent compared with early December.

WIRE.—Base prices are 30 cents for rubber-covered, 26 to 28 cents with varied deductions on weatherproof, and 24 to 25 cents for bare. Fair stocks of cable are on hand, but smaller sizes are relatively scarce.

LAMPS.—The demand is vigorous, with a tendency toward longer deliveries.

FLEXIBLE ARMORED CONDUCTOR.—Stocks are very short, with little chance of substantial improvement for four or five months. Prices are chaotic, a recent sale of No. 14 single-strip at $100 per thousand feet reflecting the market scarcity. More common quotations, subject to change, are from $85 to $88.

NON-METALLIC FLEXIBLE CONDUIT.—Bins are almost bare and such material as arrives is immediately absorbed. A rough price Monday was $30 net per thousand feet for ⅝-in. conduit.

ARMORED FLEXIBLE CONDUIT.—Prices are demoralized on account of the scarcity of this material.

RANGES.—Some sales are reported, notwithstanding last summer and fall's price advances.

PORCELAIN.—All porcelain fittings are very scarce, and orders are taken subject to market price on the day of factory shipment. Nailit knobs are quoted, when available, around $26.40 per thousand f.o.b. Boston, in standard packages, and 3-in. tubes at $7.50 per thousand, standard packages.

CONDUIT.—Deliveries are unsettled and prices irregular. Stocks are low. A tentative quotation of $83.75 per thousand feet on ½-in. black pipe was noted Monday. Buyers are obliged to take chances on price changes when purchasing under present conditions.

PORTABLE LAMPS.—An excellent holiday trade is reported. One jobber sold about 600 portable lamps in two days, just before Christmas. Retail stocks were not exhausted, but were sharply lowered, by the December trade.

WASHERS.—The demand increases and machines are sold virtually before they arrive in the jobber's stock room. Only by herculean efforts can this district avoid a shortage.

CLEANERS.—Trade is brisk, but the supply is more plentiful than in the case of washers.

MOTORS.—Deliveries are rather long, viz., 90 days on single-phase, constant-speed; four to five months on single-phase, variable-speed; twenty weeks on variable-speed, polyphase, and six weeks on constant-speed polyphase motors, taking a few representative quotations. Direct-current motors are a little freer in supply. Prices are firm.

SOCKETS.—While the manufacturers are considerably behind on orders, jobbers report an improvement maintained in supply. Pulls bring 47.5 cents, keys, 27 cents and keyless sockets 25 cents each in case lots.

TAPE.—Boston prices show little change, running around 46 cents per pound for ¾-in. black. Complaint is heard that good quality tape is scarce.

DRY CELLS.—Recent price conferences have greatly steadied prices, which quote $32.90 per hundred on No. 6 cells and $33.90 for the ignition type. Good stocks are reported, with healthy demand.

ELECTRIC WELDERS.—A vigorous and growing industrial demand exists.

ATLANTA

With the holiday season over, jobbers report a general slackening in the demand for all lines of electrical material. This condition will continue through the first of the year as the trade is not desirous of placing orders for materials before the inventory period. Building operations have slackened because of the disorganization caused by the holiday season. The annual reports of all jobbers are going to record the greatest year in their history. Bank clearings for Atlanta for the week ending Dec. 18 reached the high water mark of $91,500,000, and for the week ending Dec. 25, $71,700,000, these clearings being from 30 per cent to 50 per cent in excess of the same period last year.

The demand for distribution systems by those towns in the district who have heretofore been without this convenience, is becoming more and more pronounced. Indications are that a great many of these towns will install local plants as soon as they are able to obtain materials.

CONDUIT.—If possible, the conduit situation is becoming worse, the best deliveries at the present time being quoted at nine weeks. Stocks throughout the territory are badly depleted and jobbers announce intentions of placing orders for requirements six months hence.

WIRE.—Despite the continued strong demand, there is a slight improvement in the wire situation in the South. One of the large jobbers reports shipments in transit will help conditions materially and while there is still a shortage of No. 14 rubber-covered, the condition of stocks of large sizes has improved materially. They are quoting factory stock shipments on sizes of 500,000 cir. mills and over. Weatherproof is 29 cents and rubber-covered, 28 cents.

ARMORED CONDUCTOR.—A noticeable slackening in the demand for this article has been registered, but stocks throughout the territory are not improved. Miserably poor shipments, and anticipation of their demands by large users accounts for the slackening in demand. The demand will become brisk again in the early spring.

POLE LINE HARDWARE.—There has been a 10 per cent price advance. Stocks are in fair condition with brisk demand.

PORCELAIN.—As predicted, the porcelain market has shown a price increase of 10 per cent, which new price will control future shipments on all orders in hand. Stocks are in fair condition but shipments are not reliable.

HEATING DEVICES.—Retailers and jobbers report all stocks of heating devices badly depleted, the popular lines being practically exhausted by the holiday trade. There will be no move to re-stock on these lines until later. From announcements just released by manufacturers, prices will be quoted subject to date of shipment only.

CONDULETS.—A price increase of 23½ per cent on this commodity has been announced, despite the fact that there is a good supply in this region. The demand is reported rather dull.

MOTORS.—The demand in sizes up to 100 hp. continues very brisk, and stocks in the territory are spotty. Shipments are poor, averaging 12 weeks. One jobber, however, reports a large shipment promised for early in January. Demand for single-phase motors continues to exceed the supply, but conditions should materially improve in this line within 60 days.

SEATTLE—PORTLAND

Had it not been for delayed shipments from East and consequent shortages, this year's holiday sale in Seattle would have been considerably larger than last. As it was the total business done was nearly as large as last year. The more acute shortages were experienced in percolators, toasters, irons, heating pads and washing machines. Jobbers report retailers purchased in small quantities, but frequently.

Manufacturers in the Portland district report a slowing up in business preceding the holidays, due, partly, to the big storm, earlier in the month. Present indications are that conditions will soon be normal again. Jobbers report the usual seasonal lull in a rather pronounced form. Prices have advanced 15 per cent on all rigid metal and fiber conduit and all condulets. Indications are strong for other rises in copper soon. General retail business has been excellent. Holiday trade, according to all reports, was a record breaker, and had it not been for shortages along certain lines, sales volumes would have been considerably heavier. Principal shortages existed in vacuum cleaners, toasters and electrical tableware. Stocks in small wiring devices and supplies are growing shorter with no immediate prospects of relief. Promises of shipments on orders on eastern factories are dated ahead as far as eight or ten months.

Spokane wholesale houses report business good and retail stores assert holiday sales established new records. Electrical tableware sales particularly showed a considerable increase over last year. Collections are a little slow, particularly from the rural districts. With an unprecedented nationwide demand for lumber, a shortage of freight cars is forcing many lumber mills in Washington and Oregon to close and others to greatly reduced production.

SAN FRANCISCO

Shop keepers and store managers report a record breaking Christmas, a little marred, perhaps, by several untoward strikes. Electrical dealers also participated in this great increase.

VACUUM CLEANERS.—Stocks are arriving regularly, and repeat orders from dealers are very regular, in fact more so than those for any other line of appliances. During the last month or so, there has been an increased demand on lower priced types.

WASHING MACHINES.—During the latter portion of the year the demand has changed so the higher priced machines sell about five times as fast as the lower priced types. Special stores for the demonstration of these better types have been opened up in several cities in the most fashionable districts.

RANGES.—Sales have dropped to a very low figure, not only because of prices, but also because the power companies are not seriously pushing the sale because of lack of facilities. It is difficult to see if this condition will be bettered during 1920.

KNIFE SWITCHES.—The decrease in the number of industrial plant jobs, and the completion of such plants which were underway, will cause a serious falling off in the sale of knife switches, but it is probable that severe inspection by state officials will cause an increased sale in specially protected types.

FIXTURES.—A great many apartment house and dwelling jobs have been practically completed and are now ready for installation of fixtures. There is an increased tendency to simpler forms of lighting units. Big sales are expected for 1920 if prices remain steady.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Translucent Glass Lighting Unit

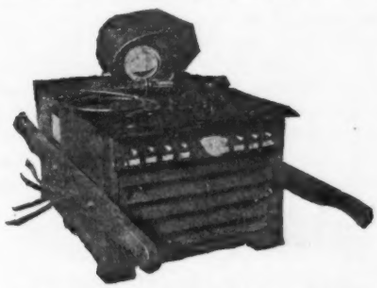
An inclosed translucent glass lighting unit designed to give a soft "velvety" illumination with good distribu-

GIVES "VELVET" EFFECT WHEN LIGHTED

tion and low absorption has been developed by the King Manufacturing Company of St. Joseph, Mo., and is called the "Ve-lu-so." No glare is said to be present when the new unit is used, since the filament of the lamp bulb can not be seen. It has been the aim of the producer to eliminate dust-collecting parts in the unit and to do away with dark ceiling shadows.

Improved Electric Arc Welding Machine

A welding machine which is equipped with a manually-operated flux controller for obtaining an arc of any desired length is now being made by the Electric Arc Cutting & Welding Company, 222 Halsey Street, Newark, N. J.



ARC OF VARIABLE LENGTH OBTAINED

The arc length controller, has no moving parts and its handle is removable so that the controller may be set for the desired length of arc and the setting device kept locked up if that is desired.

This company has also improved its alternating current arc welding machines by the addition of an appliance which is said to bring the maximum of voltage between the welding leads, or between the handle and work, or across the arc, without external appliances or wires.

Means are now provided on these welding machines for operating an electric automatic chipping hammer which is furnished with the outfits.

In addition these machines now have a rain and dustproof construction, concealed plugs for welding connection and an indicator on the machine to show the length of arc adjustment. A special cable designed for unusually long life is used for the welding leads.

Switches with Quick Make-and-Break Attachment

Fusible and no fuse single throw safety switches equipped with quick make and quick break attachments

COMPRESSION SPRING MAKES SWITCH MOVEMENT QUICK AND POSITIVE

have been placed on the market by the Trumbull Electric Manufacturing Company of Plainville, Conn., in capacities of from 30 to 600 amp.

These switches differ from the regular "Safety" switches made by this company in that no matter how the handle is moved from the "off" to the "on" position or vice versa the switch is said to always throw into the full "on" or full "off" position with a quick positive movement. This is aimed to prevent the dangerous and destructive practice of "jogging" or "edging up" the motor.

The quick action of the switch blades is accomplished by means of a compression spring working between the handle and the bearing to which the switch yoke is attached. The position of the handle and the spring is a positive indication of the location of the switch blades. In throwing the switch from "off" to "on" position, the handle's movement is approximately one of 120 deg. The first 80-deg. of movement compresses the spring but does not move the switch blades. At this point the spring lever engages the bearing and continued movement of the handle throws the spring lever over center and the spring continues the movement of the switch into full "on" position with a quick positive throw, regardless of the handle. In opening the switch the action is the same but in the reverse direction.

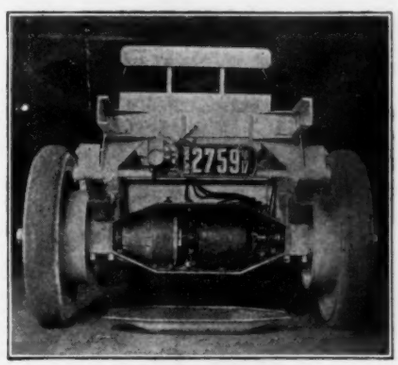
Truck with Motor and Rear Axle Combined

The motor, rear axle and driving gear of the model 2 E electric truck which has recently been developed by the Oneida Motor Truck Comany of Green Bay, Wis., are all in one removable unit.

The single motor is series wound and is mounted on annular ball bearings as part of the rear axle drive unit.

The speed of the new truck is controlled by means of a continuous torque drum-type controller that gives five forward speeds and five reverse speeds. It is mounted under the driver's seat and operated by his left hand, while the reverse pedal is worked by his left foot.

A Sangamo ampere hour meter is used to indicate the state of the battery charge. A safety switch with extra large surfaces and of the double throw type for running and charging positions is located in an accessible as-



REAR AXLE INCLOSES MOTOR AND DRIVING MECHANISM

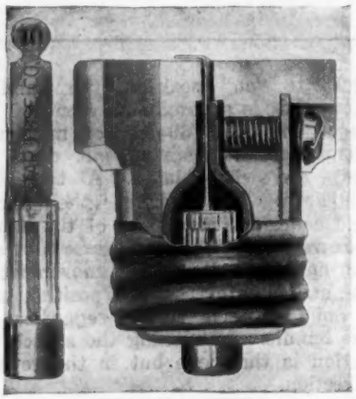
bestos-lined steel box under the driver's seat.

The new truck has a capacity of 2 tons and a loading space of nearly 12 ft. behind the driver's seat. Various styles of bodies can be used.

Renewable Fuse Plug

A plug fuse that can be renewed without taking the fuse apart is being marketed by Star Fuse Company, Inc., 290 Church St., New York, N. Y.

An inner cartridge which enters the



FUSE DOES NOT HAVE TO BE TAKEN APART FOR REFILLING

fuse from the bottom is clamped between two flat pieces of brass at the top of the plug by a screw. The other end terminates in a brass contact cap. A piece of glass tubing protects the delicate part of the fuse element from kinking or bending and holds the melted material of the blown fuse.

The fuse element projects slightly outside the plug. The rating is stamped on this projection.

Vertical Induction Motors

Vertical induction motors are now being produced by the U. S. Electrical Manufacturing Company of Los Angeles, Cal., with No. 500 frames and larger; they are known as type "S T U."

The new motors have cast shell type frames designed for rigidity. The bars

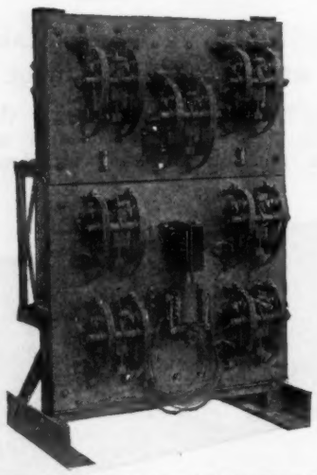
BALL BEARINGS ALLOW USE OF SMALL AIR GAPS

are brazed to the rings. Fuel bearings of large size and running in oil, are supplied at the top and bottom. The shafts are made of spindle steel. The specially treated form-wound coils and windings are of rectangular wire. Heavy insulation and improved conduits are also features of the new motors, it is said. They are designed to operate without noise or vibration and to have a large overload capacity.

Full Magnet Controller for Elevator Motors

An alternating current full magnet controller for motors in elevator service is now being made by the Warner Elevator Manufacturing Company of Cincinnati, Ohio, and is known as type A. A.

The controller's upper panel carries the main switches, two of them operating for each direction. The master magnet, which is in the center of the lower panel, operates after the main switches have closed and the plunger is raised rapidly. The piston in this plunger gradually drops by gravity and successively cuts in the four accelerating magnets. The master magnet also acts as an interlock to prevent sudden reversals. The main switches have magnetic blow outs and are mechanically interlocked.



MASTER MAGNET ACTS AS INTERLOCK TO PREVENT SUDDEN REVERSALS

The new controller is for use on motors having wound motors, the rotor resistance being supported on the rear of the board by an angle-iron frame.

Oil-Immersed Switch Operated by Clapper Type Magnet

An oil-immersed magnetic contactor, operated by a clapper type magnet, and designed to have a rigid mechanical structure and reliability in operation has been developed by the Cutler-Hammer Manufacturing Company of Milwaukee, Wis. This contactor has a capacity of 100 amp. at 2200 volts, and is declared to be particularly useful as a main line switch for an automatic 2200 volt motor starter, or for the remote control of a 2200-volt light or power circuit. It is built with three poles, unless used with an auto-transformer starter, in which case five poles are provided.

The frame of the contactor, which is of heavy sheet iron, is arranged for wall or switchboard mounting, and carries two case iron supports with two insulated shafts carrying the contacts.

OIL TANK REMOVED SHOWING CONTACTS AND ARCING SHIELDS

The copper leaf brush contacts have auxiliary arcing contacts. The armature is pivoted to the frame, and is connected by a rod to an arm of the shaft carrying the moving contacts. The attraction of the armature against the face of the magnet rotates the shaft and closes the switch, which is normally held open by the weight of the moving parts.

A sheet metal tank contains the oil for immersing the contacts. The arc is broken at the contacts in a horizontal direction the maker points out. Transit shields are supplied to prevent arcing across adjacent poles.

This new oil-immersed switch may be arranged to have two contactors act as a reversing switch.

Stone Conduit Splits, Elbows and Couplings

Three new forms of "Stone-Duct," a conduit for underground electrical conductors made of magnesium limestone and "Portland" cement, have been produced by the Chicago Stone Conduit Company, 2701 Addison Street, Chicago. One is an 18-in. straight split. The second is a coupling with one square and one round end. The purpose of this piece is to connect new lines of stone conduit, which is round, to old lines of square clay tile. It is stated that cable can be pulled either way through these couplings without stoppage. The third piece is a 45-deg.

CURVE, COUPLING AND SPLIT OF STONE CONDUIT

curve or elbow which is intended to facilitate covering power house and substation cables which curve around pipes or corners. These curved pieces can be cut with a hack saw to any angle, the maker states.

Manufacturers' Activities

JEWELL ELECTRICAL INSTRUMENT COMPANY, CHICAGO, ILL., is starting a $50,000 factory.

THE SCHROEDER HEADLIGHT & GENERATOR COMPANY, Evansville, Ind., has changed its name to Sunbeam Electric Manufacturing Company.

TUBULAR WOVEN FABRIC COMPANY, Pawtucket, R. I., proposes the erection of a new two- and four-story plant, which will cost about $200,000 equipped.

METRIC APPLIANCE CORPORATION has been formed to manufacture ammeters, voltmeters and electrical specialties. Executive offices are at 299 Broadway, New York City, and Albert W. Franklin is president.

THE GENERAL ELECTRIC COMPANY has announced that it will erect a new branch factory in Decatur, Ind., the second one in the Central West, the other being at Fort Wayne. The new plant will be a one-story building, 200 x 300 feet, brick and steel. It is planned to have the factory start operations March 1, 1920 and employment will be given to 500 persons.

NORMA COMPANY OF AMERICA, manufacturers of "Norma" precision bearings, on Dec. 10 moved its factory from the Bronx, New York City, to Anable Ave., Long Island City, N. Y., where a modern four-story reinforced concrete building has been acquired. Under the new arrangement a largely increased factory space is secured, making possible the increased output of "Norma" bearings necessitated by the growing demand for these units. The new plant is being rapidly equipped with the special machines needed for precision manufacture, and the full capacity will be available shortly. The executive offices at 1790 Broadway have been consolidated with the factory at the new address.

MIDWEST ENGINE COMPANY, held its annual sales convention in Indianapolis and Anderson, Ind. About forty district representatives were present. In particular the diesel engine, centrifugal pump and steam turbine departments were visited and inspected.

THE WADSWORTH ELECTRICAL MANUFACTURING COMPANY, COVINGTON, KY., recently suffered a loss by fire of practically all the stock in its factory where the three upper floors of the building were entirely destroyed. However, all the manufacturing machinery located on the first floor was saved. The building is now rapidly being rebuilt and the factory is expected to be again producing enclosed externally-operated switches by the beginning of the new year.

EDISON ELECTRIC APPLIANCE COMPANY, INC., CHICAGO, ILL., announces that its engineering department, after careful investigation and experimentation, is to redesign its old line of furnaces. Some time of course must elapse before the company can obtain the formed bricks and other necessary material. Until such time as the company's proposed line can be made ready for shipment, no literature or prices on the furnaces will be issued and sales will not be pushed. A new bulletin on these devices will be ready for distribution early in 1920.

THE EDWARDS VALVE AND MANUFACTURING COMPANY, East Chicago, Ind., has converted its shop into an electric washing machine factory.

AMERICAN RADIO AND RESEARCH CORPORATION is building a new factory of about 28,000 sq.ft. at Medford Hillside, Mass., for motor manufacture.

BLAW-KNOX COMPANY, PITTSBURGH, PA., held a convention of its salesmen, engineers and representatives in Pittsburgh, the first week in Dec.

ROME WIRE COMPANY, ROME, N. Y., advises that it is adding a new electric furnace for bronze, a heat treating furnace for annealing, new machinery and enlarging its buildings. The company hopes by spring to be in better shape on shipments.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, EAST PITTSBURGH, PA., has been awarded contracts by the Navy Department for the electrical machinery for three of the new battleships. The price of the three sets was $5,500,000. A duplicate set of the electrical machinery is being built at the New York Navy Yard.

THE WOODROW MANUFACTURING COMPANY, NEWTON, OHIO, has about completed the erection of a new $100,000 factory having 25,000 sq.ft. of floor space for the manufacture of washing machines. The building is of fireproof steel and concrete construction 200 ft. x 46 ft., two stories in the front and three in the rear.

EMERSON ELECTRIC MANUFACTURING COMPANY, ST. LOUIS, MO., is selling one million dollars worth of 7 per cent cumulative preferred stock, the proceeds to be used for the construction of a new factory building immediately adjoining its present St. Louis factory. The company manufactures practically every type of electric motors of two horsepower and smaller.

METHODS OF PACKING DISCUSSED AT CHICAGO.—Reducing the $200,000,000 annual loss from faulty packing, a good share of which is on electrical goods, was the object of a meeting called by the Chicago (Ill.) Association of Commerce, Dec. 4. Standard specifications for boxes and crates, materials and nailing were discussed. Members of the Forest Products Laboratory, American Railway Express and American Railway Association gave valuable information which they have compiled from tests and practice.

NEW SIX-LAMP CARTONS ADOPTED.—The Edison Lamp Works and the Westinghouse Lamp Company have provided a new six-lamp carton because, they say, of the increasing tendency of their customers to use various sizes of lamps and the necessity of the agent having a proper package to care for this business. The carton hold six lamps of 50-watts and under, and caters to the common practice of purchasing merchandise in half and dozen lots. Exterior decoration has been reduced to a minimum, thereby eliminating the necessity for wrapping and the expense of material and labor involved. The charge to the agents is three-quarters of a cent each, which the companies claim is less than that of paper and twine. Stocks of the old five-lamp cartons have not been exhausted yet.

ANNUAL SALES CONVENTION OF MIDWEST ENGINE COMPANY

PEERLESS INSULATED WIRE COMPANY, 90 West Street, New York City, a Delaware Corporation, has filed notice with the Secretary of State of an increase in capital from $1,000,000 to $4,620,000.

GENERAL ELECTRIC COMPANY has purchased the Symington Company plant in Rochester, N. Y., with the intention of using it to manufacture fractional horsepower motors. About 1000 will be employed at the start.

ROBBINS & MYERS COMPANY'S new plant at Brantford, Canada, is far enough advanced that some production is expected by the end of January, 1920, although several months more will elapse before the plant is producing on any large scale.

FAIRBANKS, MORSE & COMPANY will erect in Chicago, Ill., a building to cost $315,000, three stories, 150 x 300 ft., located at 38th Street and Loomis Place., in the central manufacturing district. The new structure will be built so as to carry two additional stories if needed.

W. D. WARD has been transferred from the San Francisco office of the Pelton Water Wheel Company to the New York Office as manager of the Atlantic department, which includes the territory east of the Mississippi, Europe and South America. Mr. Ward has been with the Pelton company for twenty-five years, of late as contract and sales engineer. In New York he succeeds F. W. Gay.

THE WAGNER ELECTRIC MANUFACTURING COMPANY has plans drawn for a new $650,000 factory in St. Louis, Mo., for making small motors. Reinforced concrete construction will be used. The main building is to be 400 ft. by 60 ft. and two wings will each be 60 ft. by 60 ft. The whole will have six stories and a basement. Central station power will be used. Bids will be called for early in January. The foundation contract has been let.

ROLLER-SMITH COMPANY, NEW YORK, N. Y., announces that its California representative, the Electric Material Company, 589 Howard St., San Francisco, has opened a Los Angeles office in the Title Insurance Building. The Los Angeles office is in charge of E. H. Bell who has had extensive experience in marketing electrical products. The Electric Material Company handles the Roller-Smith lines of electrical measuring instruments, watt-hour meters and circuit breakers in California, Nevada and parts of Oregon and Idaho.

GRAY & DAVIS MAKING RECORD PRODUCTION.—Gray & Davis, Inc., Cambridge, Mass., report the largest business in the company's history. Over 400 electric starting and lighting systems are being produced daily and by Jan. 1 a further increase of 25 per cent is expected. Plans are being carried forward to produce about 1000 sets a day by next summer. It is announced that the Amesbury (Mass.) factory is now turning out 3000 lamps per day, with prospects of an increase to 4000 lamps by New Year. It is stated that the gross sales of starting and lighting equipment for 1919 will probably total about $5,000,000 and that lamp sales will reach $1,000,000. A 75 per cent increase over these figures is anticipated in 1920. Large orders have been received recently from the Bethlehem, American and Chandler motor interests. The company is developing a new house-lighting system which is expected to be in production in about two months.

HURLEY MACHINE COMPANY PLANS BIG CAPITAL INCREASE.—At a special meeting of the stockholders of the Hurley Machine Company held at the company's offices in Chicago, October 2nd, it was voted to change the capitalization in so far as the common stock was concerned from 15,000 shares of a par value of $100 to 200,000 shares of no par value. This new stock will be exchanged on the basis of seven shares for one of the old common stock. An increase in the membership of the board of directors from five to nine was also authorized. An offering to the common stockholders of record October 15th, of 10,000 shares of the new common stock at $35 per share was also authorized. The proceeds from the sale of this stock are to be used in the extension of the company's present plant facilities. The demand for the company's products, which includes the Thor line of electric washers, ironing machines and vacuum cleaners, has grown very rapidly in the past few years and has necessitated the building of large additions to its present plant. The new board of directors will consist of the following: Edward N. Hurley, chairman. Neil C. Hurley, Samuel Felton, John Burnham, Edward F. Carey, Joseph E. Otis, Silas Strawn, Alva J. Fisher, and Edward N. Hurley, Jr.

Supply Jobbers' Notes

RUMSEY ELECTRIC COMPANY, 1231 ARCH STREET, PHILADELPHIA, PA., **has purchased the 5-story, 25 x 167 ft.** building at 1007 Arch Street. Extensive alterations will be made before occupancy.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY announces that the next annual meeting of the Westinghouse Agent-Jobbers' Association will be held at the Homestead, Hot Springs, Va., during the week of July 26, 1920.

J. F. DAVIS has been appointed sales manager of the Western Electric Company, New England district, with headquarters at 385 Summer Street, Boston, Mass. Mr.

J. F. DAVIS

Davis is a native of Newport, Ind., and was graduated from Purdue University in 1909, where he took an engineering course. With the exception of two years, his entire business experience has been with the Western Electric Company. He started in the sales organization at Chicago and spent about eight years in that office. For a short time he was in the General Department at 195 Broadway, New York City. He brings to New England the point of view of the Central Western electric supply jobber and is being cordially welcomed to the sales forces of the electrical industry in his new territory.

Foreign Trade Notes

ELECTRICAL CATALOGS NEEDED IN BELGRADE CONSULATE. — Requests have been received at the Belgrade Consulate for catalogues of recent date of electrical equipment.

ELECTRICAL ENGINEERS LISTED IN COLOMBIA.—The Bureau of Foreign and Domestic Commerce has compiled a list of "Electrical Engineers of Medellin," Colombia, under number 40802 C.

TRADE JOURNALS AND CATALOGUES DESIRED FOR CONSULATE.—American electrical supply manufacturers and firms interested in China as a market are requested by the Vice-Consul at Tsinanfu to send their trade papers and catalogues to his office.

INCREASED USE OF ELECTRIC VEHICLES IN ITALY.—The shortage of gasoline during the war has brought about considerable use of electric vehicles in Milan, more particularly for heavy trucking. There is one electric garage in Milan which operates electric buses and is organizing a corporation with a capital of 3,000,000 lire ($600,000) to manufacture and operate electric vehicles. It is connected with the Società Generale Italiana Accumulatori Elettrici, which will make the batteries. The company would like to form a combination with some American concern manufacturing electric trucks.

LAMPS REQUIRE NO LICENSE FOR CZECHOSLOVAKIA.—The Administrative Board of Import and Export Commission at Prague advises that electric lamp bulbs may be imported into Czechoslovakia without license.

ELECTRIC LAMPS IN SIBERIA.—The Consul at Vladivostok, Siberia, reports 685,000 lbs. of electric lamps in customs warehouses in that city on July 25, 1919. This is an increase of about 50 per cent over the report for June.

IMPORTS INTO AUSTRALIA.—A proclamation has been issued prohibiting the importation without a license into Australia of brass and copper bars, rods, tubes, sheet and wire, zinc, storage batteries and cotton covered electric wire.

IMPORTS OF ELECTRICAL MATERIAL INTO CHINA VIRTUALLY CONSTANT.—In 1917 China imported $4,107,788 of electrical material and fittings, while in 1918 these importations increased only to $4,930,900, according to recent information.

SWISS ELECTRICAL MANUFACTURERS UNDERBID BRITISH ON TURBINES FOR SCOTLAND. — The Corporation of Edinburgh has accepted a tender submitted by Messrs. Brown, Boveri & Company of Baden, Switzerland, amounting to £106,618 for turbo alternators required for the large new power station at Portobello. The lowest British bidder was £174,075. When the tenders were received it was found that the three lowest all came from Switzerland. After the Swiss tender was received the corporation communicated with the three leading British bidders, but these all replied that they could not make any reduction in their prices.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

The purchase of electric welding machinery is desired by a man in Roumania (No. 30,836). Correspondence may be in English.

A firm in Roumania (No. 30,679) desires to purchase asbestos packings, motor machinery and electrical apparatus. Correspondence may be in English.

A trade organization in Greece (No. 31474) desires to purchase and secure an agency for the sale of electrical supplies. Correspondence must be in English.

The purchase is desired by a firm in Switzerland (No. 30,680) of enameled wire, size 0.05 mm. to 0.08 mm. Terms of payment, cash. Correspondence may be in English.

An agency is desired by a man in Italy (No. 30,729) for the sale of electric lamps. Quotations should be given c. i. f. Italian port. Correspondence should be in Italian or French.

A company in Spain (No. 31,399) desires to secure agencies for the sale of cables, wire, switches, portable lamps, insulators, etc. Correspondence should be in Spanish or French.

A busines man in England (No. 31,223) desires to secure an agency or act as sales manager or representative of electrical and mechanical engineering firms. Payment, salary and commission basis.

A firm in South Africa (No. 31,402) desires to get in touch with manufacturers with a view to securing an agency for the sale of electrical motor cars; also of elevators for passenger and freight.

A Chinese resident in the United States, (No. 31,457) desiring to export American goods to China, proposes to open a commission house, and wishes to receive catalogues and price lists of electrical supplies.

The president of an American trading corporation (No. 30,858) is soon to sail for the Balkan countries and desires to secure agencies for the sale of small electric motors, magnetos and armored cables.

Johnson & Phillips, Ltd., London, England, transformer manufacturers, will shortly open an office in Sydney, Australia, under the direction of E. A. Kinsley. Mr. Kinsley is desirious of getting in touch with American firms in regard to supplies of transformer oil. Detailed specifications are requested, and if possible prices per English gallon c. i. f. & e. Sydney. Address Johnson & Phillips, Ltd., Box 740, G. P. O. Sydney, Australia. Specifications are in the hands of the Electrical World.

Trade Publications

CARGO CRANES.—N. B. Payne & Company, 25 Church Street, New York City, have issued bulletin No. 1 on their electric cargo cranes.

SAUSAGE MAKING OUTFITS.—The Brecht Company, 1201 Cass Avenue, St. Louis, Mo. has issued a folder covering its electric driven sausage making outfits.

WASHING MACHINES.—The Laun-Dry-Ette Manufacturing Company, of Cleveland, Ohio is circulating an illustrated folder about its electric washing machine.

VALVE.—The Nordstrom lubricated plug valve is the subject of a number of booklets recently issued by the Merrill Company, 121 Second Street, San Francisco, Calif.

LIGHTNING PROTECTORS.—The Shaw Insulator Company, 7 King Place, Newark, N. J. has issued Bulletin A-16 covering its moulded insulation and lightning protective equipment.

DRILLS AND TAPPERS.—The Barnes Drill Company, 814 Chestnut Street, Rockford, Ill., has issued a circular on its motor-driven self-oiling all-geared 24-inch drill and tapper.

GENERATING SETS.—Direct current generating sets in sizes of 1 to 50 kw. are covered in catalog No. 103 issued by Engberg's Electrical & Mechanical Works of St. Joseph, Michigan.

MOTION PICTURE PROJECTOR.—The Master Machine Tool Company, 2638 Park Avenue, New York City, describes its new "Master" motion picture projector in several recently issued circulars.

LIGHTING FIXTURES.—The Moran & Hastings Manufacturing Company, 16 West Washington Street, Chicago, Ill., is circulating an illustrated folder covering its "Raymo" adjustable lighting fixture.

ENGINE AND RADIATOR HEATERS.—The Majestic Electric Development Company, of Philadelphia and San Francisco, is circulating a folder on its electric engine and radiator heater for use in garages.

New Incorporations

THE PALMYRA (KY.) LIGHT & POWER COMPANY has been incorporated by Lewis A. Kahl, Jesse J. Kahl and W. W. Cullins.

THE LOUISVILLE (N. Y.) POWER CORPORATION has been chartered with a capital stock of $20,000 by G. P. Matthews; V. A. Warren and W. F. Wilson of Louisville, N. Y.

THE WINDSOR COUNTY BATTERY COMPANY has been incorporated with a capital stock of $10,000 by D. H. Gray, C. O. Randall of Springfield, Vt., and L. H. Barry of Charleston, N. H.

THE RANWOOD MANUFACTURING CORPORATION of New York City, N. Y., has been incorporated by C. A. Wolf, L. B. Morehouse and M. D. Bird, 80 Fifth Avenue, New York City. The company is capitalized at $200,000 and proposes to do a general electrical and mechanical engineering business.

THE RUBES AUTO ACCESSORIES MANUFACTURING COMPANY of New York, N. Y., has been incorporated by W. G. McIvor, D. A. Posner, 233 Broadway, New York, N. Y., and C. Cobb, Cedarhurst. The company is capitalized at $100,000 and proposes to manufacture auto accessories, electric dynamos, etc.

THE AGENDA NOVELTY MANUFACTURING COMPANY of Brooklyn, N. Y., has been chartered with a capital stock of $25,000 to manufacture electrical and mechanical novelties. The incorporators are: F. E. Bloch, 545 West Eleventh Street; H. J. Lauman, 601 West 112th Street, and D. Goldfoile, 157 East Eighty-ninth Street, New York City.

SERVICE of Syracuse, N. Y., has been incorporated by W. H. Craig, 718 Allen Street; W. N. Henderson, 137 Lexington Avenue, and J. M. Dunne, 704 Midland Avenue, Syracuse, N. Y. The company is capitalized at $75,000 and proposes to manufacture electric apparatus and machinery, auto accessories, etc.

New England States

CASTLETON, VT.—The Staso Milling Company is planning to enlarge its plant. The proposed extensions will require 1,500 hp. Requests for this power have been made for July 1, 1920. The Rutland (Vt.) Railway, Light & Power Company furnishes the Staso Milling Company with energy to operate its plant.

WINDSOR, VT.—Improvements and extensions are contemplated by the Windsor Electric Light Company early in the spring of 1920. New equipment will be installed, including a 200-hp. twin-runner turbine wheel and possibly a 250-kva., three-phase generator and control switchboard panel for above. Richard P. Osgood, superintendent, will have charge of the work.

MEDFORD, MASS.—The Malden Electric Company has purchased a site on Salem Street on which it proposes to erect a substation and office.

CRANSTON, R. I.—Plans have been prepared by the United Wire & Supply Company of Auburn for the construction of an addition to its local plant, to cost about $100,000.

ESMOND, R. I.—Contract has recently been awarded for the erection of a new mill for the Esmond Mills, to be located at North Providence, to cost about $120,000. Considerable electrical and mechanical equipment, it is understood, will be required.

BRIDGEPORT, CONN.—Arrangements, it is understood, have been completed by the Bryant Electric Company for the construction of a one-story machine shop and automobile service station, to cost about $17,000.

STAMFORD, CONN.—The street lighting committee is considering the installation of a new street lighting system, to cost $47,575 per year. The proposed contract provides for 931 incandescent lamps the same as last year, except that the candle power lamps will be changed from 60 to 100 cp. to cost $23,775; 147 ornamental lamps, $14,700; 74 overhead arc lamps, $6,600. The cost of the installation will be $2,940. The Stamford Gas & Electric Company furnishes the street lighting service.

Middle Atlantic States

CLARENDON, N. Y.—The Western New York Utilities Company of Medina has petitioned the Public Service Commission for approval of a franchise granted by the officials of Clarendon to erect transmission lines and furnish electrical service here.

ENDICOTT, N. Y.—Plans are under consideration by the Endicott-Johnson Corporation for the construction of a new power plant.

HAMDEN, N. Y.—The Hamden Electric Light Company has petitioned the Public Service Commission for permission to construct and operate an electric light and power plant in Hamden. The company will operate in Delaware County.

LONG ISLAND CITY, N. Y.—Arrangements are being made by the Queens Electric Light & Power Company for the erection of a new automobile service plant on Read Street, near Jane Street, to cost about $150,000.

ROCHESTER, N. Y.—S. Henmann contemplates an addition to his plant at 65 Sullivan Street, to cost about $35,000; also the installation of an electric power plant and erection of transmission line, to cost from $12,000 to $15,000.

SCHENECTADY, N. Y.—Plans are being prepared by the General Electric Company for the construction of a new building at its local plant, to cost about $400,000. Harris & Richards, Drexel Building, Philadelphia, Pa., are architects.

BAYONE, N. J.—Arrangements are being made by the board of managers of the Bayone Hospital for the construction of a new power plant and mechanical laundry at the institution. The cost is estimated at about $250,000.

DOVER, N. J.—Arrangements are being made for extensions and improvements to power plant No. 7 at the Picatinny Arsenal, to cost about $25,000. A new machine shop, to cost about $15,000, magazine buildings, shell sectioning, structures and other extensions will also be made.

NEWARK, N. J.—Contracts will soon be awarded by G. C. Higby, architect, 207 Market Street, Newark, for construction of plant for H. Boker & Company, 101 Duane Street, New York, N. Y., on Burnett Avenue, Hilton, a suburb of Newark. The project will include a main building, 135 ft. by 135 ft., three stories, a shop 75 ft. by 135 ft., one story, and a power house, 50 ft. by 80 ft.

PERTH AMBOY, N. J.—Considerable electrical and mechanical equipment will

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

be required in connection with the construction of a new dry dock, mechanical and electrical shops at the plant of the Perth Amboy Dry Dock Company, foot of Broad Street. Lockwood, Greene & Company, 101 Park Avenue, New York, N. Y., are architects and engineers.

SOUTH RIVER, N. J.—Preparations are being made by the Board of Public Works for the installation of two steam turbines in the municipal electric light plant. The cost of the proposed improvements is estimated at about $140,000. E. B. Hedden is superintendent.

TRENTON, N. J.—The Mercer Motors Company is contemplating enlarging its plant. The cost including machinery is estimated at $650,000. E. S. Hare, 245 West 55th Street, New York, N. Y., is president.

TRENTON, N. J.—The Crescent Insulated Wire & Cable Company, Olden & Taylor Streets, is considering extensions to its plant. Negotiations have been completed for additional property on Webster Street, as a site for the proposed building. Arrangements, it is understood, are being made for the installation of oil-burning equipment in its power plant, to replace coal-operated apparatus now in use.

CONNELLSVILLE, PA.—Plans are being prepared by the Yough Electric Company for the construction of a new plant.

FREEBURG, PA.—Plans are under consideration by the Northumberland County Gas & Electric Company of Sunbury for the installation of an electric light and power system in Freeburg.

GETTYSBURG, PA.—The Borough Council has called a special election to submit to the voters the proposal to issue $20,000 in bonds to establish a municipal electric light plant.

HAZELTON, PA.—The Harwood Electric Company has been awarded contract for furnishing electricity for operation of the proposed coal washery at Silver Brook.

PHILADELPHIA, PA.—Plans are under consideration by the Philadelphia & Reading Railroad Company for the reconstruction of its power plant at the Huntington Street Station, recently destroyed by fire. The loss is estimated at about $10,000.

READING, PA.—The Metropolitan Edison Company has closed a contract with the Eastern Pennsylvania Railways Company of Pottsville to supply electricity in the town of Pottsville. The contract calls for a minimum of 2000 kw., which is to be increased to 4500 kw. as needed. To supply this service a high-tension line will be erected from Reading to Hamburg, which is the junction point of the two companies.

WILKES-BARRE, PA.—Plans have been prepared for the construction of an addition to the plant of the Kitsee Battery Company, 62 North Main Street, to cost about $10,000.

WILMINGTON, DEL.—Plans have been filed for an addition to the plant of the Unger Storage Battery Company, Twelfth and Madison Streets.

ANNAPOLIS, MD.—Contract has been awarded by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for a new power plant at the local station to Leavering & Carrigues, 552 Twenty-third Street, New York, N. Y.

JANELEW, W. VA.—The installation of an electric light plant and waterworks system in Janelew is under consideration. Burton M. Davisson is reported interested in the project.

WOODSTOCK, VA.—The Woodstock Electric Light & Power Company is contemplating the installation of two water wheels.

WASHINGTON, D. C.—Bids will be received at the office of the chief engineers, U. S. Army, Washington, D. C., until Jan. 16 for furnishing switchboard feeder panels under advertisement No. 27.

WASHINGTON, D. C.—Bids will be received at the office of the chief signal officer, U. S. Army, Washington, D. C., until Jan. 14, under circular Pr 2,345—1CP, for furnishing six 100-line telephone switchboards.

WASHINGTON, D. C.—Bids will be received at Machinery and Engineering Materials Branch, Regular Supplies Division, Munitions Building, Washington, D. C., until Jan. 7 for furnishing, under circular 136, 1,000 ft. No. 19 lead-covered cable, 150-pair paper insulated.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., some time in the future, under Specificatfon 3,708, for furnishing and installing turbine-driven pumps, feed-water heaters, V-notch meter, filters, forced draft fan and forced draft duct, boiler flues, storage tank, extension to coal conveyor, coal chute, coal gate, coal weigher and piping and appurtenances in the boiler plant at the navy yard, Washington, D. C. A deposit of $20 will be required for plans.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Washington, D. C., until Jan. 6, Schedule 5,296—500 storage batteries. Until Jan. 13, Norfolk, Va., Schedule 5,305—one motor-generator set. Until Jan. 20, Mare Island, Cal., Schedule 5,302—300 gal. insulating varnish. Washington, D. C., Schedule 5,310—single-conductor wire, 142 lb. magnet wire and miscellaneous fixture wire. Application for proposal blanks should designate the schedule desired by number.

North Central States

DETROIT, MICH.—The Clayton & Lambert Manufacturing Company, Beaubien Street, is planning to erect a power plant and a factory along the tracks of the Detroit Terminal Railway, to cost about $500,000.

IRONWOOD, MICH.—At an election to be held in January the proposal to issue $290,000 in bonds for construction of new water works system with pumping plant at Spring Creek, 6 miles north of Ironwood, to replace the present plant at Montreal River, will be submitted to the votors. The plans provide for three electrically and two auxiliary gasoline engine-driven centrifugal pumps.

NORTHVILLE, MICH.—The Detroit Board of Health is planning to build a municipal Tuberculosis Sanitarium in Northville, to include an administration building, infirmary, service building, laundry, ambulance building, nurses' home, laboratory, buildings for employees and power plant. The cost is estimated at about $1,000,000. Stratton & Snyder, Union Trust Building, Detroit, are architects.

CANTON, OHIO.—The Dillon Electric Company contemplates the purchase of a number of machine tools.

CELINA, OHIO—A motor-driven water pump, capacity 400 gal. per minute, remote from power house will be installed in connection with the municipal electric light and water plant. A 400 or 450-hp. boiler is needed for the plant and may be purchased this summer. C. W. Howard is superintendent.

CONNEAUT, OHIO.—Preparations are being made for improvements to the municipal electric light plant, including the installation of a 1000-kw. steam turbine and three switchboard panels and also the construction of 1200 ft. of underground conduit, 4/0. Contract for the work will be let sometime during this month. Benjamin Laubach is superintendent.

EAST LIVERPOOL, OHIO—Plans are being prepared by the Ohio River Power Company for the erection of a transformer station with connecting buildings, to cost about $600,000.

WEST BARBERTON, OHIO—Plans are being prepared by the Portage Rubber Company for the construction of a power plant and office building, to cost $200,000. Bids, it is understood, will soon be asked for the work.

BENTON, KY.—Contracts, it is reported, have been awarded for the installation of an electric light and power plant.

DECATUR, KY.—The General Electric Company of Schenectady is planning to establish a branch plant in Decatur for the manufacture of small motors.

PAINTSVILLE, KY.—A number of improvements are contemplated by the Paintsville Light & Power Company during the early part of the year.

BLOOMINGTON, ILL.—Plans are under consideration to erect cluster lamps on twelve blocks in the city.

LOCKPORT, ILL.—The Trustees of the Sanitary District of Chicago have voted to build a new hydro-electric power plant at Lockport, to cost about $2,000,000. Of this amount $750,000 will be spent this year.

BIG FALLS, WIS.—Preparations are being made by the Big Falls Water Power Company for the construction of a hydro-electric power plant at the Big Falls of the Flambeau River. The plans provide for an ultimate development of 20,000 hp., consisting of four generating units of 5,000 hp. each. Electricity will be transmitted over a double-circuit, three-phase transmission line to Ladysmith (22 miles), Ashland, and will furnish energy to the Ironwood & Bessemer Railway & Light Company, which serves several communities in Wisconsin and in the northern peninsula of Michigan. L. E. Myers is president.

BRUCE, WIS.—Bonds to the amount of $12,000 have been authorized for improvements to the municipal electric light plant.

DARLINGTON, WIS.—The city of Darlington is considering the purchase of the plant of the Darlington Electric Company, to be owned and operated by the municipality.

GRAND RAPIDS, WIS.—The Consolidated Water Power & Paper Company is planning to build a new hydro-electric power plant, increasing its present output by 2500 hp. The company also contemplates the erection of a new sulphite mill, to cost more than $500,000.

MONROE, WIS.—The Monroe Electric Company contemplates an extension to its power plant.

BELVIEW, MINN.—The Northern States Power Company of St. Paul contemplates extending its transmission line from Belview to Sacred Heart. G. O. House, 76 West Third Street, St. Paul, is manager.

CHESTERFIELD, MINN.—The Teal Light & Power Company is contemplating the installation of a duplicate electric generating unit in its plant. D. T. Teal is president and manager.

CLEARBROOK, MINN.—The Clearbrook Electrical Company is planning to build a power house and also to install an ornamental street lighting system.

DULUTH, MINN.—Extensions and improvements involving an expenditure of about $9,000,000, are contemplated by the Minnesota Steel Company to its local plant. The plans provide for the erection of a large wire mill, changes in various mills and additional equipment at the power plant. The construction of 250 additional houses to be erected at Morgan Park. George L. Reis is vice-president.

GOODRIDGE, MINN.—The City Council is considering the purchase of a municipal electric light plant; also the proposal of the Goodridge Milling Company to furnish energy to operate the same.

KELLOGG, MINN.—The Wisconsin-Minnesota Light & Power Company of Red Wing, is planning to extend its electric transmission lines from Wabasha to Kellogg.

SHEVLIN, MINN.—The installation of a municipal electric light plant in Shevlin is under consideration.

KANSAS CITY, MO.—The Kansas City Power & Light Company has petitioned the Public Utilities Commission for permission to issue $9,998,000 in stock and $8,000,000 in bonds. Application has been filed by the Standard Electric Light Company of Kansas City, Kan., for authority to transfer its plant and other property to the Kansas City Power & Light Company. Extensive additions and improvements are contemplated by the Kansas City (Mo.) corporation.

ARTHUR, N. D.—The Farmers Elevator Company is contemplating the purchase of a 20-kw., 110-volt, direct-current generator, 2 miles of No. 8 weatherproof wire, and Duncan Electric meters. J. A. Burgum is secretary and manager.

HETTINGER, N. D.—Extensions and improvements are contemplated by the Hettinger Electric Light & Power Company early in the spring, including the installation of two 72-in. by 18-ft. boilers, one 250-hp. engine, one 150-kva., generator and six 75-kva., 13,200-kva., transformers, and also the erection of 24 miles of transmission lines between Lemmon, S. D., and Hettinger. G. Smith is owner and manager.

BRIDGEWATER, S. D.—The Bridgewater Electric Power Company may possibly purchase high-tension transformers in the spring. G. W. Laing is president.

McINTOSH, S. D.—Bids will be received until Jan. 5 for $25,000 in bonds, the proceeds to be used for the installation of a municipal electric light and power plant.

MILLER, S. D.—At an election to be held on Jan. 6 the proposal to issue $40,000 the proceeds to be used for sinking a 1,100 to 1,200 ft. 8 or 10-in. artesian well, with pumps and pumping equipment, and also an 80 or 100 ft., tower and 80,000-gal. tank. J. C. Bang is manager of the municipal electric light and power plant.

REE HEIGHTS, S. D.—The Council has granted E. L. Hague a franchise to install and operate an electric lighting plant in Ree Heights.

LINCOLN, NEB.—The Omaha, Lincoln & Beatrice Railway Company is planning to extend its car-line from University Place to Haverlock, a distance of 2½ miles, in the near future. Contracts have been awarded for the work. J. M. Bramlette is general manager.

MORRILL, NEB.—Bonds have been authorized for improvements to the municipal electric light and power plant. New equipment, including a new engine will be installed.

SCRIBNER, NEB.—Plans are under consideration by the Scribner Artificial Ice Company to construct electric and ice plants, to cost $40,000 and $25,000 respectively.

ELLSWORTH, KAN.—The Weber Electric Power Company is planning to extend its electric transmission line to five or more small towns to supply electrical service. Benjamin A. Bearnes is superintendent.

HUGOTON, KAN.—Bonds have been authorized for the installation of a municipal electric light plant. The site has not yet been selected or contract awarded for the proposed plant.

HUTCHINSON, KAN.—Plans, it is reported, are being prepared for extensions to the plant of the United Water, Gas & Electric Company to meet the increasing demand for electrical service in surrounding towns.

LANE, KAN.—Bonds to the amount of $15,000 have been voted for the erection of an electric transmission line from Lane to Ossowatomie.

RICHMOND, KAN.—Bonds to the amount of $20,000 have been authorized for the construction of an electric transmission line from Richmond to Ottawa.

Southern States

ASHBORO, N. C.—The Water and Light Department is in the market for the purchase of a 150-hp. boiler, a 250-hp. engine directly connected to a 200-kva. generator. M. M. Rogers of Ashboro is engineer in charge. Leo R. Barker is superintendent.

NEWBERNE, N. C.—Extensions and improvements to the municipal electric light plant are under consideration.

SUMMERVILLE, S. C.—The installation of an electric light, to cost about $40,000, is under consideration by the Commissioners of Public Works.

AMITE, FLA.—The Central Light & Power Company is contemplating improvements to its plant including the installation of additional machinery.

SALLISAW, OKLA.—Improvements to the municipal electric light plant, to cost about $30,000, are under consideration.

CLARENDON, TEX.—The Texas Gas & Electric Company contemplate extensions to its local system.

DONNA, TEX.—The Donna Light & Ice Company is planning extensions to its power plant, including the installatior of new machinery. The company has increased its capital stock from $10,000 to $40,000.

FORT WORTH, TEX.—C. O. Thorp of Fort Worth has applied to the state engineer of New Mexico for permission to con struct a reservoir and hydro-electric plant on the Pecos River, about five miles north of the Texas line. The site of the proposed reservoir is near Red Bluff. The cost of the project is estimated at about $600,000.

HOUSTON, TEX.—The question of extending the municipal belt railroad to Morgan's Point, situated on the north side, and converting the system into an electric traction line is under consideration by the Harbor Board and the City Council. The cost of the main line extension to Morgan's Point and Goose Creek is estimated at about $1,000,000.

ROCK SPRINGS, TEX.—The Rock Springs Light Company is contemplating the construction of an electric light and power plant in Rock Springs. V. A. Brown is interested in the project.

Pacific and Mountain States

TACOMA, WASH.—The installation of a 500-kw. automatic switchboard in the municipal street railway substation is under consideration by the city officials. Llewellyn Evans is general superintendent.

BEND, ORE.—Application has been made to the state engineer by the Bend Water, Light & Power Company for 50 sec.-ft. of water from Tumalo Creek. The plans provide for a development of 4225 hp. and for construction of two concrete dams and canal. The cost is estimated at about $229,000.

CALEXICO, CAL.—Bonds to the amount of $11,000 have been voted for the installation of police and fire-alarm systems in Calexico.

FULLERTON, CAL.—Arrangements are being made by the City Council for the installation of a new electric lighting system in sections of Spadra and Commonwealth Avenues and also in the residential districts. Cast-iron standards will be used for the former installation and marbelite standards for the latter.

SAN ANDREAS, CAL.—R. W. Olmstead of Manteca is considering the construction of two dams, 120 and 130 ft., ½-mile tunnel and power plant in San Andreas. The cost of the project is estimated at about $2,000,000.

SAN PEDRO, Cal.—The Van Camp Sea Food Company, Fourteenth Street and Waterfront, contemplates the construction of an ice and cold storage plant and a wharf, 250 ft. long. The cost is estimated at $300,000.

VENTURA, CAL.—The construction of hydro-electric plants and irrigation projects on Sespe and Pivu Rivers is under consideration by the Sespe Light & Power Company, Merchants Trust Building, Los Angeles. The company has been granted a certificate of convenience and necessity by the State Railroad Commission on condition that the company furnishes satisfactory financing plan and sufficient data to enable the commission to determine the feasibility of the project by Mar. 1, 1920. The first unit is to include two reservoirs of 51,000-acre-ft. of power conduit. 3,000-ft. pressure pipe line, 1,000 ft. head and a 10,000-kw. hydro-electric power plant, to be increased to 18,000 kw. when second unit is built; second unit, 100,000 acre-ft. storage reservoirs, 90,000 ft. of conduit, 4,000 ft. pressure pipe line, 2,300 ft. head and an 8,000-kw. plant; third unit additional storage to deliver 100,000 acre-ft per annum for irrigation. About $100,000 has been expended for preliminary surveys. F. Buren is president.

WESTPOINT, CAL.—The Mokelumne River Power & Water Company of San Mateo contemplates the construction of two power plants, one 6,000 hp. and the other 12,750 hp.; two diversion canals, 4½ and 5½ miles long, and reservoirs in south, middle and north forks of Mokelumne River. The cost of the project is estimated at about $1,288,500.

Canada

HALIFAX, N. S.—The Nova Scotia Power Commission has been authorized to proceed with the development of the water powers at St. Margaret Bay to supply electricity in Halifax. The plans for the initial development provide for 7800 hp. at a cost of about $1,000,000. H. K. Smith is chief engineer of the commission.

CHATHAM, ONT.—Extensions are contemplated to the Chatham hydroelectric system, to cost about $90,000. J. G. Jackson of Chatham is engineer.

HAVELOCK, ONT.—Plans are being prepared by the Ontario Hydro-Electric Commission for the installation of hydroelectric power system in Havelock. At an election to be held Jan. 5 the proposal to issue $29,000 for the project will be submitted to the ratepayers. J. W. Bryans is clerk.

IROQUOIS FALLS, ONT.—Large extensions, it is reported, are contemplated by the Abitibi Power & Paper Company to its paper mills and power development, etc., to cost about $3,000,000.

LAKEFIELD, ONT.—At the January election a by-law to authorize the installation of a hydro-electric system in Lakefield will be submitted to the ratepayers. The cost of installing the proposed system, which include the reconstruction of the present distribution system and the purchase of same from the local company, is estimated at about $33,500.

Miscellaneous

WAILUKU, MAUI, H. T.—Extensions and improvements are contemplated by the Island Electric Company, including the installation of a 250-hp. Diesel engine directly connected to a 175-kw. generator and the erection of 20 miles of transmission lines. Jesse C. Blair is manager.

Directory of Electrical Associations

Printed in the First Issue of Each Month

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co.

AMERICAN ASSOCIATION OF ENGINEERS. Secretary, C. E. Drayer, Nepecnauk Bldg., 63 East Adams St., Chicago, Ill.

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AMERICAN INSTITUTE OF CONSULTING ENGINEERS, INC. Secretary, F. A. Molitor, 35 Nassau St., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country.

AMERICAN PHYSICAL SOCIETY. Secretary, Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio. nnual Meeting, St. Louis, Mo., Dec. 30-Jan. 2.

AMERICAN SOCIETY FOR TESTING MATERIALS. Sec.-Treas. C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

AMERICAN WELDING SOCIETY. Secretary, H. C. Forbes, 29 W. 39th St., N. Y. City.

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ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, Preston S. Millar, Electrical Testing Laboratories, N. Y. City.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, John F. Kelly, Empire Building, Pittsburgh, Pa.

ASSICIATION OF MUNICIPAL ELECTRICAL UTILITIES (of Ontario). Secretary, S. R. A. Clement, 190 University Ave., Toronto, Ont., Can.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Joseph A. Andreucetti, Chicago & Northwestern Railway, Chicago, Ill. Annual Meeting, Chicago, Ill. Oct. 28-31.

BRITISH COLUMBIA ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary-treasurer, Capt. W. J. Conway, 406 Yorkshire Building, Vancouver, B. C. Annual Meeting, Vancouver, B. C. Oct. 19.

CANADIAN ELECTRICAL ASSOCIATION, affiliated with N. E. L. A. Secretary-treasurer, W. Volkman, Toronto Power Company, 12 Adelaide St., East, Toronto, Ont.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary-treasurer, F. O. Safford, Denver Gas & Electric Co., Denver, Col.

CONFERENCE CLUB. Secretary, Sullivan W. Jones, 19 W. 44th Street, New York City.

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ELECTRICAL SUPPLY JOBBERS' ASSOCIATION. General secretary, Franklin Overbagh, 411 South Clinton St., Chicago, Ill.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, ATLANTIC DIVISION. Secretary, E. Donald Tolles, 52 Broadway, New York City.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, PACIFIC COAST DIVISION. Secretary, Albert H. Elliot, 502 Flatiron Building, San Francisco, Cal.

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ELECTRIC POWER CLUB. Secretary, C. H. Roth, 1410 West Adams St., Chicago, Ill.

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ILLUMINATING ENGINEERING SOCIETY. General secretary, Clarence L. Law. Sections in New York, Philadelphia, Pittsburgh, Cleveland, Chicago and Boston.

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INSTITUTE OF RADIO ENGINEERS. Secretary, Alfred N. Goldsmith, College City of New York, New York. Annual Meeting, New York City, Jan. 7.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). General secretary, C. le Maistre, 28 Victoria Street, Westminster, London, S. W., England.

IOWA SECTION, N. E. L. A. Secretary-treasurer, M. G. Linn, Des Moines, Iowa.

JOVIAN ORDER. Jupiter (president), Arthur J. Biez, Houston, Tex.

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NATIONAL ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary, W. H. Morton, 110 West 40th St., New York City, N. Y. State associations in Alabama, Arkansas, Connecticut, Georgia, Kansas, Illinois, Indiana, Iowa, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New York, Ohio, Oregon, Pennsylvania Tennessee and Wisconsin. Annual convention, Baltimore, Md., Oct. 6.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary-treasurer, William L. Smith, Northeastern College, Boston, Mass.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive Assistant to President, M. H. Aylesworth, 29 W. 39th St., New York. Annual Convention, Pasadena, Cal. May 18-21.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1350 Marquette Building, Chicago, Ill.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass.

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NEW ENGLAND SECTION, N. E. L. A. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass.

NEW MEXICO ELECTRICAL ASSOCIATION. Secretary-treasurer, Charles E. Twogood, Albuquerque, N. M. Annual Meeting, Alberquerque, N. M., February.

NEW YORK ELECTRICAL CREDIT ASSOCIATION. Secretary, Franz Neilson, 120 Broadway, New York City.

NEW YORK ELECTRICAL SOCIETY. Secretary, George H. Guy, 29 West 39th St., New York City.

NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION. Affiliated with N. E. L. A. Secretary, W. E. Herring, 860 Stuart Bldg., Seattle, Wash.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus.

OKLAHOMA UTILITIES ASSOCIATION. Secretary, H. A. Lane, 611 State National Bank Building, Oklahoma City. Annual Meeting, Oklahoma City, Feb. 10-13.

PACIFIC COAST SECTION, N. E. L. A. Secretary, A. H. Halloran, Rialto Bldg., San Francisco, Cal. Annual Meeting, Hotel Del Monte, April 7-9.

PENNSYLVANIA ELECTRIC ASSOCIATION. State Section N. E. L. A. Secretary, H. M. Stine, 211 Locust St., Harrisburg, Pa.

PUBLIC SERVICE ASSOCIATION OF VIRGINIA. Secretary, W. J. Kehl, Virginia Railway & Power Co., Richmond, Va.

PUBLIC UTILITIES ASSOCIATION OF WEST VIRGINIA. Secretary, W. C. Davisson, West Virginia Water & Electric Co., Charleston, W. Va.

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SOCIETY FOR ELECTRICAL DEVELOPMENT, INC. General manager, J. M. Wakeman, 29 West 39th St., New York City.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Dean F L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

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SOUTHERN CALIFORNIA ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary-treasurer, J. E. Wilson, 425 Consolidated Realty Building, Los Angeles, Cal.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, H. S. Cooper, 403-4 Slaughter Building, Dallas, Tex.

SOUTHWESTERN SOCIETY OF ENGINEERS. Secretary, C. E. Barglebaugh, 721 First National Bank Building, El Paso, Tex.

TECHNICAL AND HYDROELECTRIC SECTION OF THE N. E. L. A. Secretary, W. C. Anderson, 29 West 39th St., New York City.

TORONTO ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, E. F. W. Salisbury, 615 Yonge St., Toronto, Ont.

TRI-STATE WATER AND LIGHT ASSOCIATION. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C.

VERMONT ELECTRICAL ASSOCIATION. Secretary-treasurer, A. B. Marsden, Rutland, Vt.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 175 West Jackson Blvd., Chicago, Ill. Annual Meeting, St. Louis, Mo. Jan. 27-29.

WESTERN SOCIETY OF ENGINEERS, ELECTRICAL SECTION. Secretary, E. S. Nethercut, 1735 Monadnock Block, Chicago, Ill. Annual Meeting, Jan. 28, Chicago, Ill.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, J. P. Pulliam, 1408 First National Bank Building, Milwaukee, Wis. Annual Meeting Milwaukee, Wis. March.

(Issued Dec. 16, 1919)

1,324,792. APPARATUS UNIT; Wilfred E. Booth, New York, N. Y. App. filed Apr. 17, 1918. Combines resistance and capacity elements.

1,324,793. AUTOMATIC ENGINE CONTROL FOR INTERNAL-COMBUSTION POWER UNITS; William W. Bucher, Chicago, Ill. App. filed June 2, 1916. Threeway control for isolated electric plants.

1,324,796. TELEPHONE-EXCHANGE SYSTEM; Louis W. Carroll, Riverside, Ill. App. filed Sept. 14, 1917. Operator's set automatically connected to calling line.

1,324,797. ELECTROLYTIC APPARATUS; Louis W. Chubb, Edgewood Park, Penn. App. filed Apr. 27, 1917. Collects gases from cells.

1,324,798. SIGNALING SYSTEM; Roy D. Conway, Chatham New Jersey. App. filed May 24, 1917. Controlled from a distance over single circuit.

1,324,810. ELECTRIC ADVERTISING-SIGN; Martin Gold, Chicago, Ill. App. filed Apr. 12, 1917. Shop window display.

1,324,813. CONTROL APPARATUS; Arthur J. Hall, Wilkinsburg, Penn. App. filed June 6, 1916. Operation of liquid rheostats.

1,324,814. SYSTEM OF CONTROL; Arthur J. Hall and Laurence M. Perkins, Wilginsburg, Penn. App. filed Aug. 4, 1916. Excitation governed for either accelerating or regenerative action.

1,324,818. APPARATUS FOR MEASURING ELECTRICAL RESISTANCE; Allen B. Hazard, Berwyn, Ill. App. filed Nov. 23, 1917. Wheatstone bridge circuit.

1,324,819. CONTROL APPARATUS; Frederick G. Hickling, Wilkinsburg, Penn. App. filed Dec. 8, 1915. For either direct or alternating current.

1,324,840. CONTROL SYSTEM; Paul L. Mardis, Wilkinsburg, Penn. App. filed Sept. 21, 1916. Governing apparatus by energy obtained from shunt circuits to resistors connected in series.

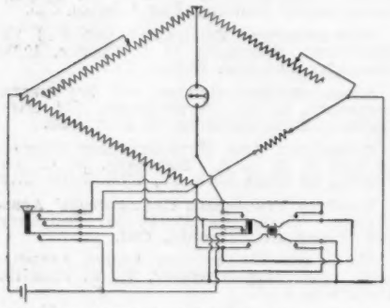
1,324,847. AUTOMATIC SWITCH; Osvald E. Rasmussen, West Hoboken, N. J. App. filed Dec. 1, 1916. Multiple brush type.

1,324,903. SAFETY-SWITCH MECHANISM; Charles Klink or North Fayette Township, Allegheny County, Penn. App. filed Sept. 10, 1918. Automatic cut out for grounded machine.

1,324,908. MULTIPLE SWITCH; Hubert F. Krantz, Brooklyn, N. Y. App. filed Mar. 22, 1916. Single exterior operating handle.

1,324,910. ELECTRIC SWITCHBOARD; Hubert F. Krantz, Brooklyn, N. Y. App. filed Mar. 10, 1916. Single switch element.

1,324,915. CIRCUIT-CLOSER; Raymond E. McKee, Chicago, Ill. App. filed Nov. 15, 1915. Low tire pressure signal.



1,324,818—Apparatus for Measuring Electrical Resistance

1,324,923. DIRECTION-SIGNAL FOR AUTOMOBILES; John Pfeifer, Springfield, O. App. filed Apr. 12, 1917. Arrow indicates direction.

1,324,924. INDICATING DEVICE; Edwin Pfister, Cincinnati, O. App. filed Oct. 5, 1915. For street car stops.

1,324,954. STORAGE-BATTERY SEPARATOR; Campbell C. Carpenter, Niagara Falls, N. Y. App. filed Apr. 12, 1918. Prevents treeing across.

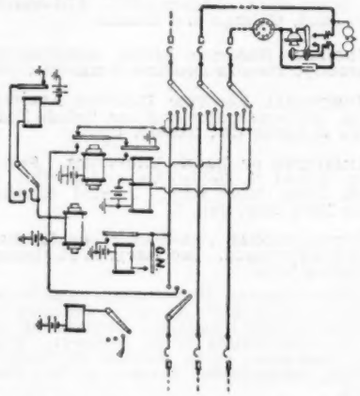
Record of Electrical Patents

Notes on United States Patents

1,324,959. VIBRATION-DETECTOR; Charles A. Finley, Brooklyn, N. Y. App. filed Feb. 23, 1918. Microphone button attached to ship.

1,324,969. ELECTRICALLY-HEATED INSTRUMENT; Frank Huhn, Jay A. Hand, and Jules G. Spiess, Detroit, Mich. App. filed Jan. 25, 1919. Heat conduction a minimum.

1,324,989. DYNAMO-ELECTRIC MACHINE; William A. Turbayne, Niagara Falls, N. Y. App. filed May 31, 1916. For starting and lighting systems.



1,324,847—Automatic Switch of Multiple Brush Type

1,324,994. CONNECTOR FOR ELECTRIC WIRES; Reuben B. Benjamin, Chicago, Ill. App. filed Oct. 25, 1917. For branch circuits.

1,325,005. DRIVING MECHANISM FOR VALVES AND OTHER DEVICES; Peter P. Dean, New York, N. Y. App. filed Sept. 10, 1917. Electro-mechanical release.

1,325,007. ELECTRICAL CONNECTOR; H. A. Douglas; App. filed Nov. 21, 1917. Connector and key in cylindrical shell.

1,325,011. ELECTROMAGNETIC CLUTCH; Bernard E. Fernow, Jr., Milwaukee, Wisc. App. filed June 5, 1916. Annular type.

1,325,015. BATTERY-PLATE; Roy Benson Hall, Chicago, Ill. App. filed Dec. 16, 1918. Stiffening ribs both vertically and crosswise.

1,325,016. MAGNETO-CIRCUIT BREAKER; William S. Harley, Milwaukee, Wisc. App. filed June 29, 1917. Prevents back flow of current through generator.

1,325,022. IRONING APPLIANCE FOR SHOE-TREEING MACHINES; Edwin N. Lightfoot, New York, N. Y. App. filed Mar. 19, 1917. Obviates cord connection.

1,325,052. PANEL-BOARD AND PANEL-BOARD CONSTRUCTION; Henry F. Starrett, Chicago, Ill. App. filed May 15, 1918. Provided with wire gutters.

1,325,096. SWIVEL ATTACHMENT-PLUG; Otto Kessler, Passaic, N. J. App. filed Dec. 26, 1918. For socket and plug.

1,325,112. BURGLAR-ALARM LOCK; Simpson B. Rodgers, Macon, Ga. App. filed Sept. 27, 1917. Illuminated signal alarm.

1,325,114. ELECTROCONVERTER-FURNACE; Paul Francois Sarron and Jules Simon, Lyon, France. App. filed June 8, 1918. For special steels.

1,325,115. PRIMARY BATTERY; Charles B. Schoenmehl and Martin L. Martus, Waterbury, Conn. App. filed Mar. 16, 1917. Flat shaped containers form negative element while positive element is oval shaped.

1,325,131. STREET AND STATION INDICATOR; Charles W. Wright, Topeka, Kans. App. filed Oct. 25, 1915. Interior street car indicator for giving names of streets.

1,325,146. AUTOMOBILE-SIGNAL; Eugene E. De Ford, Oakland, Calif. App. filed Nov. 30, 1918. Battery operated front and rear signals, each controlled independent of other.

1,325,155. LAMP; Michal Kaczmaryk, Pottsville, Penn. App. filed Aug. 6, 1919. Multiple light for shedding beams outwardly, the light passing upward being partially obstructed.

1,325,160. CIRCUIT-CLOSING DEVICE FOR LIQUID-LEVEL GAGES; Leon G. Le Compte, Shandon, Calif. App. filed Sept. 26, 1917. Separate circuits for two contractors for regestering rise and fall of liquids.

1,325,232. ELECTRIC-MOTOR CASING; Joel R. Cook, Cleveland, O. App. filed Sept. 13 1917. Prevents short circuit by watering casing which allows full ventilation.

1,325,250. METHOD OF PROPAGATING ELECTRIC IMPULSES IN ANTENNAE; Otto G. H. E. Kehrhahn, New Rochelle, N. Y. App. filed Oct. 12, 1916. Generators in direct connection with antennae and a continuous source of current.

1,325,254. PROJECTION LIGHT UNIT; Joseph W. Legg, Worcester, Mass. App. filed Mar. 31, 1915. Refillable gas-filled projection light unit with relatively small proportion of heat given off at filament.

1,325,257. IGNITION-DYNAMO; Charles Thomas Mason, Sumter, S. C. App. filed Mar. 15, 1916. Eliminates all moving wire and makes moving parts light and desirable as an oscillator.

1,325,324. RAILWAY SIGNALING; John S. Holliday, Wilkinsburg, Penn. App. filed May 23, 1916. Regulator comprising a transformer and an impedance coil with core substantially saturated.

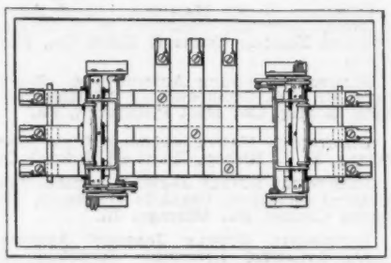
1,325,338. BATTERY-SEAL; Norman D. Sturges, Brooklyn, N. Y. App. filed Apr. 24,1918. Sealed by soldering battery lid and terminal post.

1,325,347. TELEPHONE SYSTEM; William T. Booth, East Orange, N. J. App. filed July 9, 1917. Electromagnetic means eliminates releasing any calling keys.

1,325,357. SYSTEM OF ELECTRICAL RECTIFICATION AND DISTRIBUTION; James Knox Elderkin, Jr., Newark, N. J. App. filed Oct. 30, 1916. Rectify alternating current at comparatively high voltages.

1,325,375. ELECTRIC VIBRATOR FOR RETOUCHING IMPLEMENTS; Waclaw Putbowski, Jersey City, N. J. App. filed May 5, 1919. Noiseless operation.

1,325,481. STREET OR STATION INDICATOR; Cornelius P. F. McDonnell, Kansas City, Mo. App. filed Sept. 8, 1916. Apron winds up on rollers.



1,324,910—Electric Switchboard for Heavy Power Circuits

1,325,501. IGNITION-TIMER; Edward B. Jacobson, Pittsfield, Mass. App. filed Feb. 19, 1919. Course traveled by contactor automatically lubricated.

1,325,502. IGNITION-TIMER; Edward B. Jacobson, Pittsfield, Mass. App. filed Mar. 28, 1919. Self-lubricating contactor avoids gumming.